Preflight STUDY MANUAL



FOR CIVIL AIR PATROL CADETS

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Preflight STUDY MANUAL

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FOR CIVIL AIR PATROL CADETS

CADETE HAME	
SERIAL HUMBER	
CAPE UNIT	

PREPARED BY HEADQUARTERS AAF, OFFICE OF FLYING SAFETY



America need not fear for the future so long as her young men and women are airminded. Civil Air Patrol Cadets, and others like them, will assure for this country a place
of leadership in aviation. Among you are those who will design, build and fly bigger, faster, and more powerful airplanes than we know now. It But a man must walk before he
can run, and he must work hard and long before he can fly. Those of you who want to become flyers must begin now to learn the fundamentals of your chosen profession. It Your
CAPC training program, for which this manual is a guide and aid, has been carefully
planned to give you a solid foundation of aviation knowledge. This will be of decided
advantage in flying training. It is important to your future in an aviation-conscious
world. It Flying demands a lot of you in return for the thrill and satisfaction it provides.
You must study hard, be patient, and be thorough. Be greedy to learn everything you can
about aviation. Your goal is well worth the effort.

CENERAL, U. S. ARMY, COMMANDING GENERAL, ARMY AIR FORCES

IN THIS

MANUAL

FOREWORD BY GENERAL HENRY H. ARNOLD

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CADETS OF THE CAP

In this section of your manual you and your friends will find the answers to many questions about Civil Air Patrol Cadets. * You will learn how your own particular unit of CAPC is run, and how it fits into the national organization. You will discover the type of instructors you are to have and what they will teach you. You will read with pride of the Civil Air Patrol's record, and learn what is being done for cadets by the Civil Air Patrol League. * Those friends of yours who are nut yet cadets can read here how they may qualify for membership in CAPC and learn of the advantages it offers. By letting them read the answers to their queries about CAPC you will thereby introduce them to your manual and the fascinating store of aviation facts it contains.

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The CAP

and you..

You are now a junior member of the Civil Air Patrol. That, in turn, is an auxiliary of the United States Army Air Forces. It has been so named by the War Department.

When you're engaged in cadet activities, you wear a regulation Army uniform with special CAPC insignia. The insignia is a patch sewn on the left sleeve at the shoulder. It is the regular red, white and blue CAP insignia with the word "Cadet" embeoidered beneath the blue field. If you have enlisted in the Air Corps Enlisted Reserve you may wear your miniature silver wings over the left breast pecket of your uniform, or as a pecket patch.

Behind your uniform are soldierly traditions that go back to the beginning of history. Behind it, in particular, are the traditions of the U. S. Army, never defeated in a war, and of the AAF, the mightiest air force in the world.

CAPC Organization

Your CAPC unit will be a squadron, a flight, or a section. Cadets who show qualities of leadership will command it. The harder you work, the more likely you are to succeed in qualifying for these responsibilities.

Cadet leaders are non-commissioned officers in CAPC, and it is their important task to make your unit function smoothly. Cadet non-coms are under the direction of CAP officers, who report in turn to higher CAP units. That sequence is called a chain of command. You should learn the CAP chain of com-



mand and the names of its officers up to that of the commander of your state wing.

A national command directs the CAPC and CAP. Its headquarters in New York is staffed by officers who hold commissions in the AAF. There is a wing command in each of the 48 states composed entirely of civilian volunteers. The wing commander and his staff of CAP officers direct all subordinate units in a state.

Units are usually squadrons, with 60 to 200 members, or flights of 10 to 60 members. The smallest CAP units are called sections and serve as parts of larger organizations. In heavily populated states, group commands made up of 3 or more squadrons are sometimes organized to relieve wing commanders of too much administrative work.

The Civil Air Patrol

The Civil Air Patrol, your unit's parent organization, has a short but proud and colorful history. Organized a week before Pearl Harbor, CAP was set up to mobilize civilian airmen and planes for volunteer wartime duties. War was not long in coming and CAP promptly had a big job on its hands.

Civilian pilots went to work immediately flying rescue, search, antisubmarine, courier and many other types of missions to relieve pressure on the AAF. This was done on their own time and in their own equipment.

This assistance was valued so highly that the Civil Air Patrol was made an auxiliary of the Army Air Forces in April 1943.





The Civil Air Patrol League

Groups of leading citizens throughout the country have organized the Civil Air Patrol League. Its members have in common an enthusiasm for aviation, great hopes for its future, and, in particular, a belief in the value of early aviation training. Many of them have volunteered to devote time and effort to making the CAP cadet training program an outstanding success.

At the head of the League are 2 committees. One decides what the organization's national policies will be. The other, an executive committee, guides and assists codet training activities of Civil Air Patrol, and administers funds provided for that purpose.

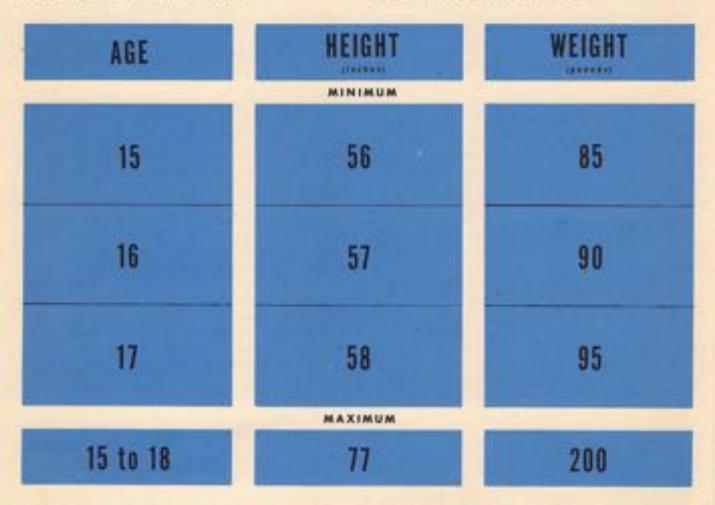
In addition, it is expected that there will be an executive committee in each state. Its purpose will be to work with both the state's CAP organization and the national body in carrying out approved policies.

Influential, air-minded citizens of cities, towns, and communities may form local committees to develop and guide CAPC flights and squadrons. These committees will be responsible for raising and using funds for this purpose in their communities, according to approved state and national policies.

Men and women who have volunteered for these committee posts were not chosen simply because they are members of CAP. Their work cannot be measured alone by their contribution to wartime flying. They work, too, for better civilian and commercial aviation with the coming of peace.

QUALIFICATIONS FOR CAP CADETS

Any boy or girl who is 15 to 18 years old may apply for training as a Civil Air Patrol Cadet. Cadets must be citizens of the United States, native born or naturalized at least 10 years. However, waivers may be granted to applicants from allied nations who have been U. S. citizens less than 10 years. Cadets must meet rigid physical standards similar to those required by the Army for flying. If you are unfamiliar with these, turn to the section called Your Body in Flight. They are described in considerable detail there. Cadets must also meet the following height and weight requirements:



If there is a unit of the High School Victory Corps in the high school which a candidate for CAPC attends, he must be a member of its Air Service Division before he can become a cadet. If there is no Victory Corps in his high school, he must show evidence of good grades in his studies, including physics, algebra and geometry, in order to apply for CAPC. If he has not taken these subjects already, he must agree to begin studying them at once.

Each applicant must be sponsored by a CAP senior member who testifies that he is of good character and qualified for membership. The applicant must also submit his parents' consent with an option as to whether or not he will be permitted to fly as a passenger. While passport photos are required for identification, the applicant does not have to furnish fingerprints or a birth certificate.

All members of the Air Corps Enlisted Reserve are eligible for CAPC membership and training while they await their calls to active duty. However, they must submit parents' consent and passport photon as in the cases of other applicants.

Purpose of the Cadet Program

The present purpose of the CAPC program is to extend pre-aviation training to young men and women of high school age who are planning on pursuing aviation careers of one kind or another. In carrying out this purpose, CAPC aims to give you rock-bottom knowledge upon which you may build more specialized learning.

Naturally, your courses in CAPC will be invaluable should it be necessary, or should you decide, to enter military aviation training. If that is the case, CAPC will have supplied you already with a comprehensive groundwork of air knowledge which will always be useful. However, in joining CAPC there is no pledge of military service. You may resign at any time.

Your Instructors

Local people will teach you. Most of them are members of CAP, well qualified to give instruction in the various phases of the course. Remember these men and women are donating their time and serving at their own expense to give you this help for your future.

Your drillmaster may be a veteran of the last war, too old for service now but eager to pass on his knowledge to those who may have to go. Your instructors in flying subjects will be skilled civilian pilots or perhaps former military pilots with plenty of flying hours behind them. You will learn Morse code from a local radio expert, first aid from a compotent medical or Red Cross instructor.

As long as you plan a career in aviation you will have to know many fundamental facts about flight. How much you learn will be entirely your responsibility. Instructors selected for you are earnest in their desire to give you a good start on your road to success in aviation. But they cannot do the whole job. They will need your help.

CAPC does not intend to teach you all there is to know about subjects covered in this manual. It attempts only to give you basic knowledge required to make you receptive to higher aviation education. If CAPC does this, then it has fulfilled its mission.

Your Job in CAPC

Your membership in CAPC will be very much like membership in a military outfit. For that reason, learn as much about your organization as you possibly can. It will be useful if you become a member of the armed forces.

Learn your own job first, then learn the jobs of other cadets in your outfit. The more you know about the other fellow's job, the easier it is to cooperate. In either military or civilian life, teamwork is always necessary for the smooth functioning of any organization.

The Manual

This manual has been prepared for you as an aid in fitting you for a place in aviation. It is designed to present material in a simple and easily understandable manner. Each section was written by an expert in his field after collaboration with many other experts on the same subject. If it does not seem to go far enough, remember its purpose. That purpose is to give you a foundation for more advanced knowledge and a clear picture of seronautical fundamentals.

CAPC will be the coach but you must carry the ball.

Don't drop it!







SOME FACTS OF ARMY LIFE



A soldier's life is not markedly different from yours. But certain things are demanded or expected of him which are foreign to sivilian ways. If you enter military service it will be of considerable advantage to you to be familiar with those things from the start. * The salute, for instance. How do you do it properly? When do you salute, and whom? What is the right way to stand at attention? What's an Article of War? How do you march a squad of men across a field, turn it around, and march it back again? What are you supposed to do when an officer enters a room where you are working? * You have to learn the alphabet before you can spell, and know how to spell before you can read. You must be familiar with simple arithmetic in order to make change. And a civillan must learn certain elemental rules and customs of the Army before he can become a capable member of it. * In this section you will find almost every fact you need to know in order to fit quickly and intelligently into the Army or Air Forces. Learn them, and you'll have a head start on the boys who weren't lucky enough to be given this apportunity.

IN THIS SECTION ...

How The Army Is Put Together

Ground Farces, Air Farces, Services of Supply—Missions of Various Ground Farces—Mission of Air Farces—Building from a Squad to an Army—Non-Commissioned Officers and Commissioned Officers—How a Company Functions—Chief Sections of General Staff

Teamwork in the Toughest Game of All

How the AAF Is Built

Organization of a Squadron, the Basic Unit—Various Kinds of Squadrons—Building from a Squadron to an Air Force—15 U.S. Air Forces—6 AAF Commands—Divisions of Headquarters

Keep Mum, Chum!

The Army's Law

How Army Expects You to Behave-Three Types of Court-Martial-The Articles of War

Paper Work

Chief Assistants to the CO

The G-Stoff, A-Stoff, and S-Stoff-The Commanding Officer-Duties of S-1, S-2, S-3, S-4

How to Influence Soldiers

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Introduction to IDR

"Attention"—"At Ease"—"Rest"—"Parade Rest"—"Fall Out"—"Fall In"—How to Dress a Line—Two
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Face"—Proper Way to March—"Holt"—Definitions of Alixement, Column, File, Rank, Interval,
Distance, Face, Piece, Guide—"Column Right"—"Column Left"—Marching by the Right and Left
Flank—Marching to the Rear

On Guard

Purpose and Make-up of an Interior Guard...Special and General Orders...The 11 General Orders... How to Summon Help, Sound Alarms...Proper Way to Challenge...Officer of the Day...Sergeent of the Guard...Corporal of the Guard...Guard Mount

On Display

Company or Squadron Inspection-Four Parts of a Review-Retreat Parade

HOW THE ARMY IS PUT TOGETHER

(ORGANIZATION OF THE ARMY)

Think of the Army of the United States, primarily, as having 3 kinds of soldiers: those who fight on the ground, those who fight in the air, and those whose job it is to supply the others with everything they need to fight.



The Army Ground Forces, as they are called officially, include the Infantry, Cavalry, Field Artillery, Coast Artillery, Engineers, Signal Corps, and Chemical Warfare troops.

The Army Air Forces not only contain the men who strike at the enemy in the skies and from the skies but those many more men who keep the planes in shape to fly.



The Services of Supply see to it that everything an American soldier needs to eat, wear, and shoot, anywhere in the world, is where he needs it when

he needs it. The only thing they don't do is to furnish the Army Air Forces with special equipment which they alone use.

The Infantry's principal mission in attack is to come to grips with the enemy and capture or destroy him; in defense, to hold its position and hurl back attacks.

Cavalry contains the highly mobile ground units. Some are still horsedrawn; most are powered by motors and move on caterpillar tracks or on wheels. Some are armored. Cavalry is chiefly valuable because its fire power

can be shifted rapidly and easily.



Field Artillery supports other ground units, either in attack or defense, by pouring heavy shell fire upon enemy troops, guns, supplies, and communication facilities.

Coast Artillery represents huge fire power which can be directed at naval or air targets. It uses both fixed and mobile heavy guns for seacoast defense, submarine mines, and fixed and movable anti-aircraft weapons.



The chief mission of the Corps of Engineers is to build structures to assist other ground troops and to demolish installations of

use to the enemy.

Signal Corps troops provide communications by messenger, wire, car-

rier pigeon, radio, and such devices as flags, for the command to which they are assigned.

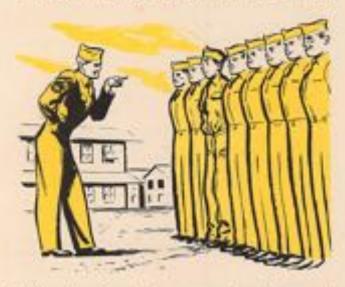
Troops of the Chemical Warfare Service join other units in combat and assist them by the use of gas, smoke, and incendiaries.

The mission of the Air Forces is three-fold: to drive off enemy aircraft. to support attacks by our own ground and naval forces, and to carry out independent attacks on the enemy's military and civil establishments.

Our Army wouldn't be worth much if it simply contained 7,000,000 or more individuals. They have to be grouped into teams to be effective.

There are teams of many sizes. The smallest is a squad. There are usually 8 to 12 men in it, though there can be as many as 16. Most soldiers learn the facts of Army life in a squad, drilling under a corporal or sergeant.

But General George C. Marshall, our Chief of



Staff, ean't plan victorious campaigns in terms of squads. He and his principal associates work out the movements of whole armies and air forces, and leave to subordinate officers, all the way down the line, the way in which the smaller teams shall be handled.

These lesser units, however, must be larger than squads. There has to be teamwork on a-huge scale. So, in the Infantry, 2 to 4 squads at a time are built

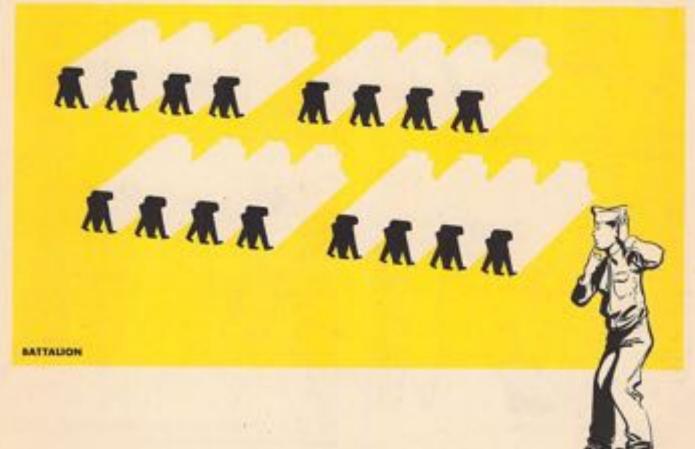
into platoons, commanded by second lieutenants. A second lieutenant is the lowest ranking commissioned officer. Three or more platoons are joined to form a company, usually headed by a captain. Four companies, as a rule, are combined to create a battalion. A battalion leader normally has the rank of major. Two or more battalions are teamed together to form a regiment, under the command of a colonel. Regiments, in turn, are built into divisions, divisions into corps, and both corps and divisions are linked to make armies. Sometimes, a super-team made up of a group of armies is formed under one commander. These larger component parts of armies are led by general officers, ranging from brigadier-generals to lieutenant-generals.

As small military units are merged in bigger ones, a chain of command is formed. This insures that every leader from squad sergeant to Chief of Staff is under the direct orders of the next higher commander. Even the Chief of Staff is responsible to the Secretary of War and the President.

For some time non-commissioned officers will provide your most direct contact with higher authority. They include corporals, sergeants, staff sergeants, technical sergeants, first sergeants and master sergeants. You will be able to tell them apart by the chevrons on their sleeves. Officers wear their insignia of rank on their shoulders.

You'll find that what the Infantry calls a company is known as a flight in the Air Forces. In the Artillery, it becomes a battery; in the Cavalry, a troop. Also, in both the Air Forces and Cavalry, a squadron is the equivalent of the Infantry's battalion. However, despite the differences in names, the relative sizes of these units remain roughly the same.





The commander of a company is responsible for everything it does or fails to do. He must see that you and every other soldier in it are properly trained, and at the same time fed, clothed, and sheltered. He must guard your health and, for morale's sake, must see that you are well entertained. Naturally, he can't handle all these matters alone. Accordingly, he asks the regimental commander to appoint non-commissioned officers to assist him.

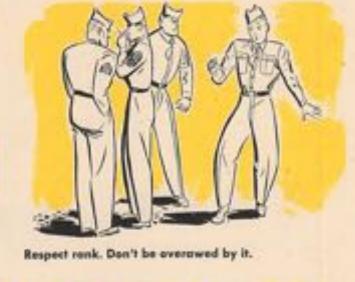
In a company headquarters the principal non-coms, as they are called, are the first sergeant, the mess sergeant, and the supply sergeant. The first sergeant has a job very much like that of a chief clerk in a civilian office. He takes care of all the administrative details of the company and publishes the company commander's orders. The mess sergeant with his cooks obtains and prepares the food you eat. The

supply sergeant issues clothing and equipment to you and exchanges it when it's worn out or damaged. Other non-come supervise drill and work details. The company is carefully organized to leave as many men as possible free for the primary job of fighting.

The men who make the principal decisions about how our mighty military forces are going to be used to win the war form a General Staff. They work under the direction of General Marshall and his Deputy Chief. They are in charge of Operations Division, which plans how the war is to be fought; Personnel Division (G-1), which provides all the men necessary to fill the ranks of the Army; Military Intelligence Division (G-2); Organization and Training Division (G-3), which gets the soldiers ready to fight; and Supply Division (G-4), which gives them everything to fight with.



There's only one right way to report to your commanding officer.





The mess sergeant determines what you eat.



The supply surgeant issues your clothing and equipment—frequently, all at once.

Teamwork

IN THE TOUGHEST GAME OF ALL

(MILITARY COURTESY AND DISCIPLINE)

If you've ever been on an athletic team, you know this: when you're trying to win a game you use the plays carefully worked out in practice. And you do your part as well and as earnestly as possible.

Suppose it's a football game. When the quarterback calls signals, you don't suddenly decide to try out an idea of your own. Swiftly, with scarcely a thought for the well-drilled details, you carry out the orders his signals represent. Perhaps they mean you've get to batter your bones against a bruiser on the other team while Johnny Jones makes an end run and gets all the glosy. Well, you take it for granted that what matters is the team, not you or Johnny. Perhaps you think the quarterback is wrong to try that particular play. But you don't stand up and start arguing with him about it. You rely on his judgment and cheerfully obey his signals.

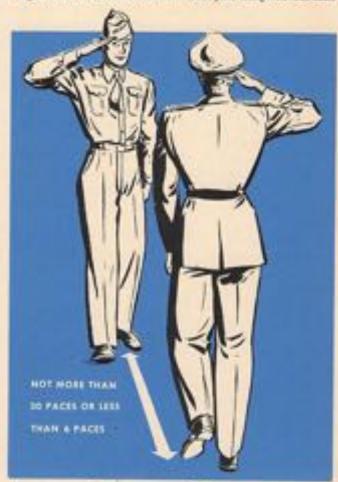
It's the same way in the Army, except that every contest is for keeps. If, in battle, you fail to carry out a play which your team has practiced, not only may the game be lost, but your life with it and the lives of the other boys in your outfit.

That is why discipline is so important to the Army. It's not a system of punishments and penalties and annoying restrictions. It is teamwork at its hest.

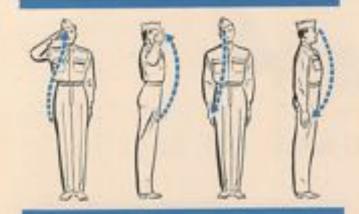
It has been proved over and over again in warfare that without discipline no body of troops in the world can hold its own against a well-directed, well-disciplined enemy. That is one reason the Army places so much emphasis on drill. On the drill field, a soldier learns to obey orders instinctively. On the hattlefield, even at the most critical moment, that training will not fail him.

Courtesy is a vital part of military discipline. It's a sign that you are alert, obeying the rules, aware of your obligations, proud of your uniform, proud of the job you're doing as a soldier, conscious of the fact that you're a very necessary player on the Army team no matter what your grade, and that you respect your leaders.

When you salute an officer correctly and anappily, looking him straight in the eye as you do so, it's as if you were saying, "How do you do, Sir? You're looking at a first-rate soldier!" And you may be certain



You must know not only how to salute, but whom and when.



that is exactly the impression he gets.

Salute by raising your right hand smartly until the tip of the forefinger touches the lower part of your cap or a spot just above your right eye. Hold your fingers and thumb tightly together, keeping the palm of the hand flat. Your upper arm will be parallel to the ground, your lower arm inclined at 45 degrees. Turn your head and eyes to face the person you're saluting. So long as you remain a private or a noncommissioned officer, you will salute officers first and hold your salute until they have returned it.

Salute all officers, women as well as men. Pay the same respect to soldiers you recognize as being officers of the armies of our Allies.

Salute, at a halt or a walk, when you are near enough for an officer to see you, yet not so close to him that he won't have time to return your salute before you've passed each other. Never salute on the run.

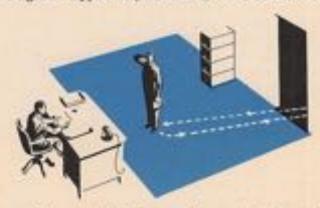
If you are part of a group outdoors which is not in a military formation, all of you will come to attention at the command of the soldier who first sees an officer approaching. Each one of you will then salute.

If you are not in formation, salute when the flag passes or is being passed by you. Face the music and salute when you hear "The Star Spangled Banner" or one of these bugle calls: "To the Colors," "Escort of the Colors," or "Retreat."

Sometimes, instead of saluting, it is proper simply to stand at attention. You do this when you are indoors and an officer enters the room. The first man to see him will shout "Attention." The rest of you will spring to your feet and take off your hats or caps, if you have them on. You will also stand at attention without saluting when you meet an officer on a staircase, or if he stops to speak to you while you are in ranks. At other times you neither salute nor stand at attention when an officer approaches. That is when you're taking part in an athletic game, when you are part of a work detail, when you are eating a meal, or if you happen to be carrying bundles in both hands.

Never salute indoors, except when reporting to an officer. If he is in an office, knock before entering and remove your hat. When told to enter, march briskly to a spot about 2 paces from his deak, salute smartly, and announce yourself.

The way to do this depends on why you're there. If he sent for you, the proper declaration is, "Sir, Private So-and-so reports as ordered." If he is your commanding officer and you have properly sought permission to see him by first obtaining the First Sergeant's approval, you will say, "Sir, Private So-



and-so has the First Sergeant's permission to speak to the Company Commander." He will immediately put you at ease and the rest of the conversation will be carried on just like any other.

However, when you leave, come to attention again, face about, and march out of the office in a soldierly manner.

Remember that your salute is the key to your character!

An American colonel who rose from the ranks once said that the day he became a member of the United States Army he was so proud that he wore his private's uniform as if it had a general's stars on the shoulders. That is the kind of spirit every soldier should have. Civil Air Patrol Cadets, however, must curb their impatience for that day to come. Don't try to pass yourself off as a regular Army man. This is a serious offense. It is unworthy of a cadet.

HOW THE

IS BUILT

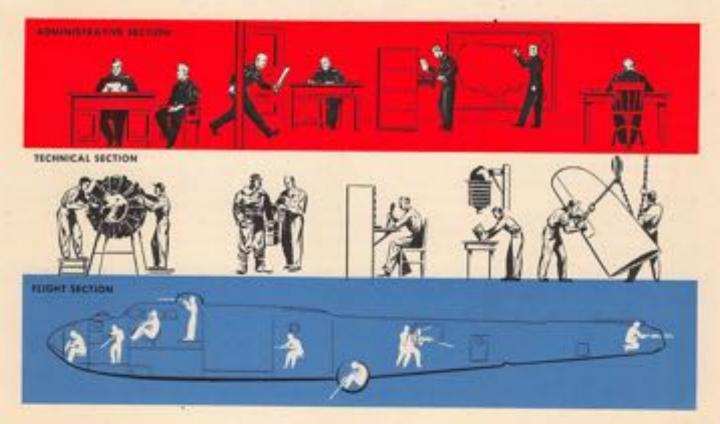
(ORGANIZATION OF THE ARMY AIR FORCES

To build an air force, you start with a plane and a combat crew. In battle plans, however, the smallest unit considered is a flight, which usually contains 3 planes. Two or more flights make up a squadron.

Just as the company is the smallest part of the Army Ground Forces able to function by itself, regulating the duties of its members, feeding them, issuing them clothing and equipment, and taking care of their health, so the squadron is the basic unit of the Army Air Forces.

If you become a member of the AAF, you will undoubtedly work and live with a squadron. It will contain soldiers with many different duties. There will be an administrative section, a technical section, and a flight section. In the first are the men who do the paper work, keep records, handle correspondence, and those who provide food and transportation. Engineering, supply, communication, photography, and repairs are provided by the technical section of the squadron. The flight section, an you would expect, flies and maintains the squadron's aircraft. There will be additional soldiers assigned from the Army Ground Forces. They will handle chemical warfare equipment and maintain the squadron's weapons.

There are all kinds of squadrons: fighter; light, medium, and heavy bombardment; observation; communication; weather; photographic mapping; photographic reconnaissance; depot repair and supply; troop carrier; transport, and so forth.



Important as they are, squadrons alone are not big or strong enough to have more than a temporary effect upon the enemy. There must be much bigger aerial teams. Accordingly, 2 or more squadrons are combined to form groups. Pairs of groups make up wings. Wings, in turn, form commands, and commands are linked to build an air force.

The United States has 15 air forces, at home and abroad. Only the first 4 of them are located within the 48 states. The Fifth is in the Southwest Pacific, the Sixth in the Canal Zone, the Seventh in Hawsii, the Eighth and Ninth in Great Britain, the Tenth in India, the Eleventh in Alaska, the Twelfth and Fifteenth in the Mediterranean area, the Thirteenth in the South Pacific, and the Fourteenth in China.

There are also 6 commands in the Army Air Forces: Training, Troop Carrier, Air Transport, Materiel, Air Service, and Proving Ground. Their names are largely self-explanatory. In addition, there is an AAF Tactical Center at Orlando, Florida, and an AAF Redistribution Center.

The Tactical Center provides the last dress rehearsal for air war. It is one of the most important factors in the final training of our air and ground crews and the testing of equipment which will be used overseas. The men live, work, and fight as they will abroad. Fighter, bomber, and patrol missions are carried out from a dozen airdromes in an actual theater of operations about as large as Sicily. Instructors and advisers are experienced officers; many of them have returned there from combat. The Tactical Center not only trains men in tactics devised in theaters of warfare but develops other battle techniques and procedures.

The AAF Redistribution Center arranges new as-

signments and sometimes additional training of a different type for Air Forces personnel returning from the war fronts.

In the organization of the AAF, these air forces, commands, and centers are on the same level of authority. Above them all is the Commanding General, Henry H. ("Hap") Arnold, and the members of the Air Staff, There is a Chief of the Air Staff, 3 Deputy Chiefs, and 6 Assistant Chiefs. The latter head the 6 principal divisions of AAF Headquarters in Washington: Personnel; Intelligence; Training; Materiel, Maintenance, and Distribution; Plans; and Operations, Commitments, and Requirements.

Other offices of Headquarters include those of the Air Inspector, Air Surgeon, Air Judge Advocate, and the Office of Flying Safety. The mission of the latter is to increase the combat strength of the Army Air Forces by reducing losses of men and aircraft in accidents.

Plans, policies, and programs for the air forces and commands are made at Headquarters. It is the mission of those units to put the plans into effect, with the advice of Headquarters offices.

Mission is a military word which means the job that has to be done. Wherever you are when you join our vast armed forces, resolve to put your heart and soul into accomplishing every mission given you.

Keep mum, Chum!

(SAFEGUARDING MILITARY INFORMATION)

They tell the story of a soldier who died because he wrote too much in a letter home, and because his mother talked about it in the village grocery. The boy had proudly confided that he was one of a small group chosen to guard some secret war materials on their way to San Francisco. He even told his mother what time the train was to leave. She excitedly boasted about it to the family grocer, and was overheard by an agent of the enemy. He swiftly arranged with other saboteurs to wreck the train, and in the



She probably never realized how it happened.

terrible accident which followed, her son was killed.

Too often, the tragic results of such thoughtlessness aren't felt by the persons who are to blame. Usually, it is somebody else's son who is blown up or shot or drowned because of careless talk.

If you enter the Army you'll want to tell your family and friends all about the things you see and hear and do, and they'll be eager to listen. They may not understand why you just can't tell them. Because they are honest and patriotic they think your information is safe with them. The sad truth is that it isn't. Sooner or later, even the best intentions won't prevent a thoughtless remark or the exchange of a few confidences which don't seem important to people who are not in military service.

They'd be shocked if they knew how important seemingly commonplace matters may be to the Japa and Germans. Just because a gun or a plane seems ordinary to you, you may think everybody knows about it. Usually they don't, for very good reasons.

So remember: don't talk about military equipment, transfers of troops, airplane accidents, where you imagine you're going to be sent, or any other details of your life as a soldier which can possibly be of value to our enemies. When relieve immediate is printed to villes at the compact as a plantly to be a made in a plantly to be a plantly as a compact as a plantly to be a plantly as a compact as a Confidential and the plantly made decomposite Secret Confidential and

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When a person enters the Army, his conduct is naturally checked on more closely than it is in civilian life. As a member of a potential fighting team, certain discipline has to be demanded of him to which he is not now accustomed. However, in the main, the Army asks only that you behave yourself according to the rules of the society in which you have been raised.

Just as you now can expect to be punished by the law if you steal, smash public property, have a fight in the street, or kill someone, so can you expect punishment if you do any of these things in the Army. In civilian life, such an act would lead to your arrest by a policeman and trial before a judge or jury. In the Army, the result would be very much the same, except that the cop would be in khaki and eventually you would be tried by a military court. Courtsmartial, they are called, and there are 3 kinds: summary, special, and general, depending on the seriousness of the offense. A general court-martial is the highest of the three.

You are already familiar with 2 kinds of laws: civil and criminal. The Army has a third set: the Articles of War. There are 121 of them and they govern the life of every soldier from private to general. They state some of his rights as well as all the things he must not do. You can read them in the "Massual for Courts-Martial, U. S. Army," but most of them you don't need to know. Simply behave yourself as you normally do and you needn't give a thought to the Articles of War.

However, there is a code of military conduct which must be obeyed as well as the more familiar rules of behavior. Accordingly, there are Articles of War which provide punishment for such misdeeds as giving a false age or false name when enlisting (Article

HE ARMY'S LAW

(ARTICLES OF WAR)

54), wilfully disobeying a superior officer (Article 64), striking or otherwise acting in an insubordinate manner towards a non-commissioned officer (Article 65), being absent without leave (Article 61), deserting (Article 58), and, most serious of all, aiding the enemy (Article 81). There are others, but these are the principal ones.

For minor acts of disobedience, there is one Article of War, the 104th, which gives your commanding officer the right to inflict upon you what is called company punishment, rather than resorting to trial by court-martial. The penalty may simply be a reprimand, but it can include temporary loss of privileges, extra fatigue duty, or even hard labor for as much as a week.

The first known Articles of War were written while Oliver Cromwell was roling England. They were called "Laws and Ordinances of Warre," and were published in 1642. Later, some of them were included in the English Mutiny Acts and Articles of War established by the King. On July 30, 1775, when an American Congress drew up a code of behavior for the first national army, it copied liberally from those sources. The next year, it enlarged upon them. Our present Articles of War date largely from 1806. Revisions in 1916, 1920, and 1927 mostly affected court-martial procedures.



PAPER WORK

(MILITARY CORRESPONDENCE)

Military letters aren't like any you ever wrote. They never start with "Dear So-and-so" or end with "Sincerely yours." Like any business letter, they should be typed. Unlike business letters, they first state what they're all about.

Supposing, after you have been in the Army awhile, it seems necessary for you to leave your post for a few days to take care of argent family or business matters. You are told to state your request in writing to your commanding officer.

After typing your address and the date at the upper right of the page, 4 lines below the letterhead and three-quarters of an inch from the edge of the paper, you will drop down 4 more lines and type:

"SUBJECT: Request for Emergency Furlough."

The word "Subject" must be capitalized and begin
1¼ inches from the left edge of the sheet. The subject should always be stated in 10 words or less.
(Never try to talk about two subjects in one military letter. Write a second letter on the other matter.)

Now, drop down 2 more lines and type:

"TO: Commanding Officer, Blank Company, Blank Battalion, Fort Blank, Blank State."

Note that no word is abbreviated. If you know your commanding officer's name, use it in full with his proper rank. The word "TO" must be capitalized and put right under "Subject."

Next, drop down 3 more lines and start the body of your letter.

If you write more than one paragraph, every one must be numbered. It must also be indented so that its first letter will be directly under the first letter of your "subject" and "to" lines. The paragraphs will be single-spaced with double spaces between them. Each is to express a single thought only.

At the conclusion of the letter, drop down 5 lines and type your full name in caps, over by the righthand margin. Immediately below it, type your grade and branch of the service, but not in capitals. Write your name in ink over the typed signature.

Number your pages, whenever there are more than one, a half-inch from the bottom of each.

You will then fold your letter in 3 equal parts, in such a manner that the top third is open to view and the bottom third is right beneath it, face up.

Your commanding officer will undoubtedly reply by indorsement. This is a way of answering letters which is peculiar to the Army.

If there is room left on the page on which you have written your request, he will begin the indorsement right there, one-half inch below the last typewritten line of the basic letter. In the center of the page he will type "lat Ind."

Then, over at the left-hand margin, which remains 1% inches, he will type his address and the date. They will be abbreviated as much as possible and will be printed 1 line below the words "1st Ind."

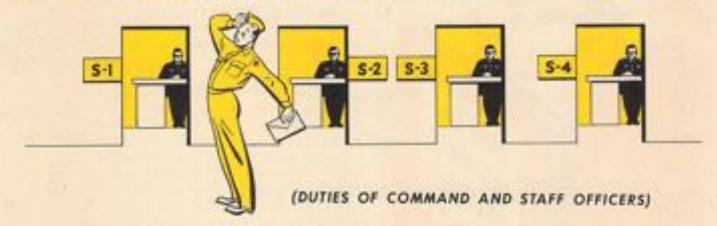
Two lines below he will type "To:." This time it will not be capitalized. Your name and address will follow the word "To."

The body of the indorsement will be written in the same form as the letter to which it replies. There can be any number of indorsements to a basic letter, provided they all are on the same subject. They will be typed on successive pages and attached to the original communication.

Remember this: Don't write unnecessary letters. Transact your military business in person or by local telephone call whenever possible.



CHIEF ASSISTANTS TO THE CO



You are already familiar with the odd symbols which indicate the 4 principal parts of the U. S. Army's General Staff: G-1, G-2, G-3, and G-4. You learned in the pages describing Army organization that, simply stated, they stand for: Personnel, Intelligence, Operations and Training, and Supply.

In the Army Air Forces, the Commanding General's staff has similar sections but they are labeled: A-1, A-2, A-3, A-4. In the units below air forces and commands (lower echelons, they are usually called) these same staff functions undergo another change of title. In wings, groups, and squadrons they are called: S-1, S-2, S-3, S-4.

If you become a member of the Army Air Forces, you probably will learn how a staff operates by watching it work in a squadron.

In the first place, you know that the Commanding Officer of any unit is held solely responsible for everything which takes place within it and what it does in battle. You also know that he can't possibly direct and supervise all these activities himself. Therefore, he has to have a staff of skilled advisers. Their job is to relieve him of detail work, provide him with all necessary information upon which to base his decisions, and then see that his decisions and orders are properly carried out.

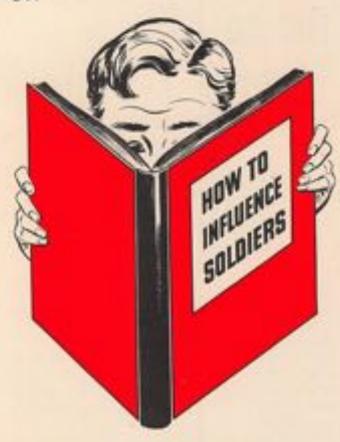
The Executive Officer of the squadron is its second in command, but it is the Adjutant who represents S-1, He's the office manager, so to speak. He handles all correspondence except that which pertains to operation missions. He keeps up and has charge of the records of all personnel and prepares reports on strength, casualties, and other such returns.

The Intelligence Officer (S-2) must work closely with the Operations Officer (S-3). He gathers all the information, confidential and otherwise, necessary to carry out operation and training missions. He supervises the preparation and use of codes for safeguarding important messages, and is responsible for the protection of classified information. When a mission is completed, he questions all crew members about what they saw and posts his findings on what is called a situation map. He is responsible for finding and getting rid of any members of the squadron who are disloyal.

The Operations Officer (S-3) is the Commanding Officer's assistant in charge of training the squadron and directing its flights. He assigns the missions and gives instructions on hew to fulfill them. He keeps a file of all official instructions on operating and flying sircraft. He checks and signs the books in which pilots keep accounts of their flights, maintains records of his unit's flying time, and determines weather conditions in areas where his men are operating. He also keeps records of forced landings and crashes, and makes summaries from time to time of the total hours flows by his unit on various types of missions. In CAP training squadrons without active missions, the S-3 function is performed by the Training Officer.

The Supply Officer (S-4) is responsible for obtaining, storing and distributing supplies, including aircraft. He also is required to supervise the maintenance of equipment and salvage operations. He has charge of the squadron's funds, acquires whatever real estate and facilities are needed, and procures and improves airplane bases.

These are the principal staff officers of a squadron. In addition, there are usually a Communications Officer and a Medical Officer. Under combat conditions, there might very well be an Armament Officer, a Photographic Officer, a Mess Officer, and so forth.



(LEADERSHIP AND COMMAND)

Napoleon used to boast that every private soldier in his Guard carried a marshal's baton in his knapsack. That was his way of saying that he felt each one of them was not only eager but able to lead a whole army if he had the chance.

The little emperor, whatever we think of his purpose, was a great military leader. He knew how to inspire his men.

No officer starts out as a skilled leader. He has to learn by experience, generally by being a non-commissioned officer first. For both enlisted men and officers, however, there are certain principles of leadership which have always proved successful.

Someone has said that proper conduct on the part of an officer can be summed up this way: Be strict, be just, be cheerful. But there is much more to it than that

Be leyal. If you act or speak disloyally towards your superiors, your men in turn will feel you probably are not loyal to them, either. They will think there is no point in trying to be loyal to you.

Be cheerful, Make a point of accepting unsatis-

factory situations with good grace. Don't crab.

Be courteous. Your men will follow your example, and admire you for it.

Be decent. You've got to prove you are morally fitted to lead. If you drink too much, live loosely, gamble extensively, run up debts, you'll lose the respect of those under your command as well as those above you.

Be careful of your speech. A good cuss word now and then to relieve your feelings in a tense situation will be understood and accepted as natural by your men. Never swear at them, however. It is particularly humiliating because they cannot retaliate.

Be calm and self-controlled, especially when things go wrong. If your men see that you neither look nor act worried, even when you have good reason to, they will gain courage and energy.

Be far-sighted. Anticipate difficulties and plan in advance how you will act, what decisions you will make when they arise.

Be studious. Never lose a chance to learn something more about your job. Don't try to bluff. Your men will find you out quickly. They don't expect you to know everything but they rightfully expect you to be honest with them.

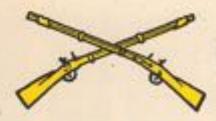
Be generous with praise when it is deserved.

A good officer will be strict but just. If a soldier deserves punishment, give it to him, but make sure it is not petty or too severe.

Be considerate, Find out everything you can about your men-their names, experience, backgrounds. They'll be grateful for your personal interest and respond to it by becoming more zealous. Just be careful that this sympathetic interest doesn't become undue familiarity, which would breed lax discipline.

Tell your men as much as possible about military jobs the outfit has to do and, in general, how you expect them to be done. American soldiers resent being kept in the dark about matters which rightfully concern them.

A capable officer will not lean on his non-coms in making decisions but, if he is wise, he will confer frequently with them. He will listen to their suggestions and use them if they are good. He will not try to do their work, but will rely on them to carry out his orders. He will let them decide how they're going to do it.



INTRODUCTION TO IDR

(INFANTRY DRILL)

You'll hear 'IDR' mentioned a thousand times if you become a soldier. Those initials stand for Infantry Drill Regulations, the rules by which a civilian is made over into a smoothly functioning member of a military team. Naturally, they are of primary importance in the Army.

Here, you will find only a part of IDR. But it's the fundamental part. Learn what's printed on these few pages and your training as a soldier will be made much easier.

The first thing to remember is that you must obey every command with snap and precision.

At the command, "Attention," stand straight, bring your heels together with a click, and be quiet. Keep your shoulders back, chest arched, eyes front, arms at your sides, toes pointed outward at an angle of about 45 degrees. Don't be stiff.

When the command, "At Ease," is given, relax but don't talk. Keep your right foot in place.

When you are commanded to "Rest," relax and talk, if you like, but keep one foot in place.

At the order, "Parade Rest," move your left foot 12 inches to the left, clasp your hands behind you and remain still.

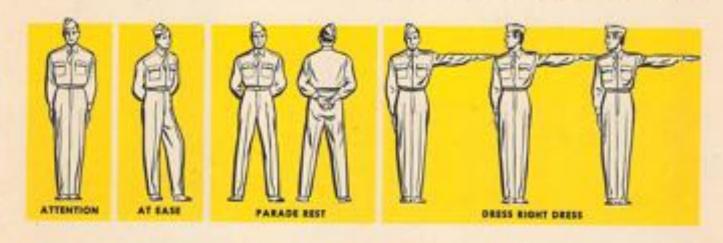
When you are told to "Fall Out," leave your position in line but stay nearby. You will not leave the drill area until given the order, "Dismissed."

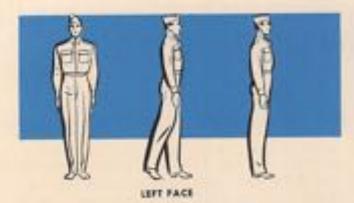
At the command, "Fall In," hurry back to the spot you left in the formation and stand at attention. When soldiers are ordered to fall in they next are generally given the command, "Dress right, dress." At this order, each man except the one at the left end of the line stretches out his left arm until his fingers touch the right shoulder of the soldier at his left. At the same time be turns his head half right and glances down the line in that direction, moving until he is exactly in line with the man at his right. The soldier at the right end of the line naturally does not turn his head to the right; the others are aligning themselves on him.

As soon as the leader is satisfied with the straightness of the line, he commands, "Ready, front." At this order, each man drops his left arm to his side and turns his head and eyes to the front.

Most military commands are in 2 parts. That is done in order to warn you of what is coming before you are actually told to do it. Take, for example, the command, "By the right flank, march." The first part, "By the right flank," prepares everyone in the squad for what he is about to do. That's why it is called the preparatory command. It is spoken loudly enough to be heard by everyone in the squad, and in rising tones, which capture more attention.

Then, after a brief pause intended to give every soldier a chance to think how he's going to execute the movement, comes the order, "March." This is called the command of execution. It is given explosively. For that reason it sometimes sounds like "March" and sometimes like a bark or somebody being strangled. But a well-drilled squad known





what's coming and at the sound, however garbled, every man snappily turns to the right.

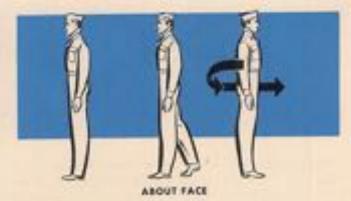
All commands of execution are barked out. "Attention," for instance, isn't forceful enough when it is pronounced "At-ten-shun." Drill sergeants invariably make it sound like "Ten-hut" and the "hut" makes a noise like the crack of a whip. Such commands cause troops to hop to obey; that's why they are given that way. Sloppy, lazy orders result in indifferent performance.

One of the purposes of drill is to enable a leader to move troops from one place to another in an orderly fashion. Before they start marching, however, it frequently is desirable to face them in another direction. There are 3 principal commands used.

When you are given the command, "Right Face," turn squarely to the right on your right heel and the ball of your left foot. Then bring your left foot into position beside your right.

At the command, "Left Face," reverse the above procedure, using your left heel and the ball of your right foot.

When you hear the order, "About Face," place your right foot about 6 inches behind your left and turn around on the ball of your right foot and the



heel of your left.

As soon as his squad is faced the right way, the leader presumably will want to move it.

"Forward, march," is the command. When you hear "March," or "Harch," as it will probably sound to you, step out promptly, left foot first. Never forget that it is the left foot which moves first.

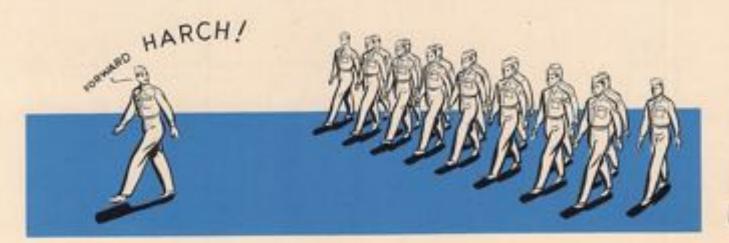
American soldiers are fortunate in being able to march in a natural way. You've seen the "goose steps" and other peculiar and exaggerated gaits of foreign armies in the movies. We, on the other hand, simply walk in a business-like manner, at a codence which insures precision but neither tires the marchers nor becomes monotonous.

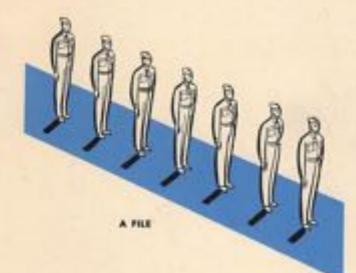
When he wants to stop his squad, the leader cries "Squad, halt." At this order, you take one more step and plant both feet firmly in that spot.

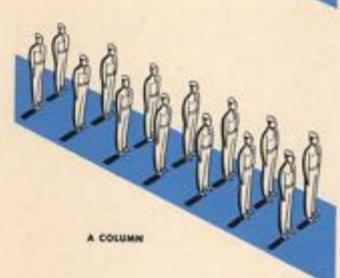
There are words the Army always uses to describe certain formations of troops and parts of formations. They are words unfamiliar to a civilian but essential for him to know when he becomes a soldier.

One is alinement. When you and other soldiers are in alinement you are in a straight line, either abreast of each other or behind one another.

A column is a formation of troops in which the







men march behind one another. There will be at least 2 rows of them and may be as many as 4.

A file is a column consisting of only 1 row of troops. A rank is a line of men side by side.

Interval is the space between you and the soldier standing beside you. "Normal interval" is one arm's length; "close interval" is about 4 inches. You will often hear the command, "Get your proper interval."

Distance is the space between you and the fellow in front of you. This is normally about 40 inches, a space just a little larger than the length of an arm stretched out straight before you.

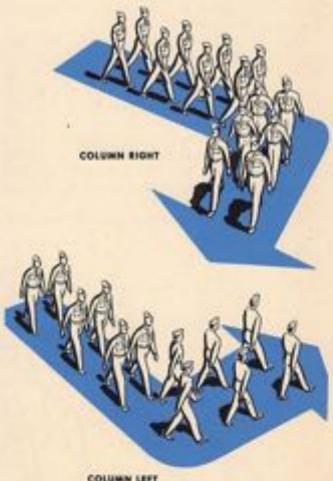
There are 3 other terms you'll hear constantly. One is pace. That means a step of 30 inches. Another is piece. That's what the Army calls a rifle. A third is guide. A guide is the officer, non-commissioned officer, or private who is placed at the head of a column or file and who, by his own marching, shows

the other troops which way to go and how fast.

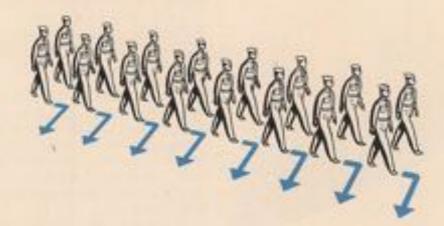
Certain essential commands are used to direct the movements of both a file and a column of soldiers. They are: "Column right (or left), march"; "By the right (or left) flank, march"; and "To the rear, march."

If the formation is a file, at the command, "Column right, march," always given as each man's right foot strikes the ground, the first soldier in line takes one more step and turns right on the ball of his left foot, He then steps off in the new direction with his right foot. Each soldier behind him does the same thing as soon as he has marched to the exact spot where the first man turned.

At the command, "Column left, march," always given as the left foot strikes the ground, the leading soldier of a file takes another step, turns left on the ball of his right foot, and steps off in the new direction with his left.



COLUMN LEFT



When a file is ordered to march by the right flank, at the command, "March," given on the right foot, every man in the file takes one step forward, turns right on the ball of his left foot and steps out in that direction with his right foot. Each uses the opposite foot but follows a similar procedure at the command, "By the left flank, march."

When ordered to march to the rear, each man obeys the command simultaneously. It is always given as the right foot strikes the ground. At the command, "March," every soldier plants his left foot forward and turns about on the balls of both feet. He then steps off in the new direction with his left.

If troops are marching in column formations, they do flanking movements and march to the rear exactly as described above. However, a somewhat different procedure is executed at the command, "Column right (or left), march."

In a column, there are 2, 3, or 4 files abreast. Since,

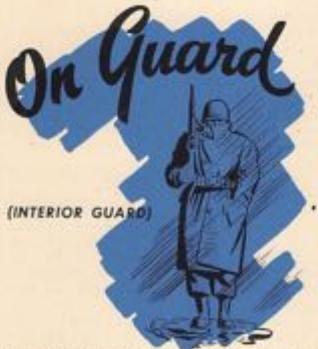
therefore, there are always at least 2 men at the head of the column, it is necessary that both of them do something simultaneously when they hear the command, "March."

If the order is given to march to the right, the soldier at right end of the first flank turns in that direction just as if he were at the head of a single file. There is one exception. After his first full step to the right he takes half steps until the men who were at his left have once more caught up with him.

The other soldier or soldiers in his rank take half turns to the right until they are going in the same direction he is. They then align themselves with him by taking half steps or full steps until they are abreast. They must always keep in time, however.

In your Army training you will be taught other ways in which these units and larger ones can be moved about, but these are fundamental. Learn them thoroughly and the rest will be easy.





One of the most important jobs you'll be given to do in the Army is that of being a sentinel. You will then be part of an interior guard, the body of armed soldiers which provides security for any camp, whether it is a permanent post or a temporary establishment of tents. The interior guard protects costly and vital Government property, keeps order, and sees to it that police rules are obeyed.

The guard must be on duty 24 hours a day. Since that is much too long a time for a sentinel to carry a rifle and stay alert, the guard is usually divided into 3 sections, called reliefs. Think of them as shifts. Each one serves for 2 hours at a time until all have guarded the camp for a total of 8 hours apiece. While one shift is walking post, the other two are sleeping or resting, though they are always on call.

Since emergencies sometimes arise which require several guards to be in one place at the same time, there have to be extra sentinels available. Otherwise, if those on regular duty were to be called from their posts part of the camp would be left unprotected. Therefore, every interior guard is composed of the main reliefs and a reserve.

Each sentinel in the respective reliefs is given a particular part of the camp to patrol. That is called his post, and is numbered. He is also given orders peculiar to that part of the camp. They are called special orders. There are other orders which apply to each and every sentinel on duty. These are general orders, and there are 11 of them. In the Army, you are required to know them by heart, since they are the sentry's code of behavior. You will be wise

GENERAL ORDERS

- To take charge of this post and all Government property in view.
- To welk my post in a military manner, keeping always on the alert and observing everything that takes place within sight or hearing.
- 3. To report all violations of orders I am instructed to enforce.
- To repeat all calls from posts more distant from the guardhouse than my own.
- 5. To quit my post only when properly relieved.
- 6. To receive, obey, and pass on to the septimel who relieves me all orders from the commanding officer, officer of the day, and officers and non-commissioned officers of the guard only.
- 7. To talk to no one except in line of duty.
- 8. To give the alarm in case of fire or disorder.
- 9. To call the corporal of the guard in any case not covered by instructions.
- 10. To salute all officers and all colors and standards not cased.
- To be especially watchful at night, and during the time for challenging to challenge all persons on or near my post and to allow no one to pass without proper authority.



to learn them before you enter military service.

If a sentinel at Post No. 3 desires to call the corporal of the guard and is justified in doing so, according to General Order No. 9, he cries out, "Corporal of the guard, No. 3." The call will be repeated by every sentinel who hears it, between No. 3 and the guardhouse.

In case fire has broken out near him, he calls, "Fire, No. 3!" If disceder is occurring and he thinks considerable help is needed, he calls out, "The guard, No. 3!" If the danger is very great, he will fire his weapon into the air 3 times before calling.

When a sentinel is required to challenge someone, he should do so about 30 steps away, holding his weapon across his chest with both hands, in the socalled port position. He calls out sharply: "Halt! Who is there?" The person challenged will identify himself as "Friend," "Soldier of the post," "Officer of the Day," or whatever he is. The sentinel then commands, "Advance, Friend (Officer of the Day, etc.), to be recognized!" He will halt him again when he is near enough to be seen clearly, yet not so near that he could, if hostile, overpower the sentinel. If he now recognizes the person challenged, the sentinel says, "Advance, Friend (Officer of the Day, etc.)!" He continues to hold his weapon at the port position, however, unless the person challenged is an officer. In that case, as soon as he recognizes him, the sentinel gives him the rifle salute.

The soldier who is responsible to the commanding officer of a camp for the proper performance of duty by the interior guard is called the Officer of the Day. Though be sometimes has an assistant called the Commander of the Guard, he usually reviews, inspects, and commands the guard himself. His principal helpers are the Sergeant of the Guard and the corporals of the guard. Generally, there is also at least I bugler.

The Sergeant of the Guard forms the guard whenever a formation is necessary. He makes sure the corporals know their duties and are performing them properly. A corporal of the guard has direct charge of each of the 3 reliefs. He must know every sentinel and where he is to stand guard. He must march his relief to and from its posts, and be thoroughly familiar with the special orders of each member of it.

A guard always forms under arms and is inspected to make certain every man's piece is in proper condition and his appearance creditable. The forming of a new guard always involves a certain amount of ceremony. It is called guard mounting, and may be formal or informal. The procedure of formal guard mount, as you would expect, is the more elaborate, involving a parade and band music. Informal guard mount takes place without either.





A lot of the pleasure and satisfaction of infantry drill comes from seeing your outfit and yourself, as a part of it, lose awkwardness and ragged timing and become almost as precise as a machine. With this charge there comes a greater desire on the part of each soldier to look his best whenever he is on the drill field. He spends more time shining his shoes, brushing his clothes, and polishing his brass buttons. He may even practice the manual of arms in front of his barracks mates and invite their criticism of his performance.

Regularly, just to keep him a little bit more on his toes, there is a company or squadron inspection. The troops are assembled, required to open ranks, and officers then pass up and down the straight lines making a personal check of the men's clothing and the pieces they are carrying. Inspections of this detailed nature usually take place before or after reviews.

Parades and reviews are the high spots of this phase of a soldier's training. If you get a kick out of being in a mappy squad on the drill field, little shavers of pride will really run up and down your spine when you march in your first review. A review has 4 parts; forming the troops, presenting them to the reviewing officer, inspecting them, and parading them. It normally is held on the largest parade ground available. Plags indicate where the troops are to line up and the route they are to march. The reviewing officer's position, opposite the center of the line of troops, is also marked by a flag.

When a review is held at Retreat, which is the end of the soldier's work day, as soon as the troops have marched to their marked positions and are presenting arms, their commander orders the bugles to sound "Retreat." Immediately afterwards, the band plays "The Star Spangled Banner." On an Army post, the evening gun is fired at the last note of the bugle call. Then the post flag is slowly lowered while the National Anthem is being played.

The troops are next brought to order arms, and the ceremony proceeds with the reviewing officer and his staff and orderlies moving to designated positions apposite them.

At this, the commander of troops brings them to attention and has them present arms. If the reviewing officer or visiting dignitary is of sufficient rank or importance to merit them, the band sounds the honors.

There is a regular table of honers. It includes the firing of gun salutes, the playing of ruffles by the drums, flourishes by the bugles, and "The Star Spangled Banner" or a march by the band. The person naturally entitled to the greatest honors is the President of the United States. He merits a salute of 21 guns, 4 ruffles and flourishes, and the playing of the National Anthem. The table of honors ends with vice consuls, who merit only 5 guns and no music.

At the conclusion of this part of the review, the troops are again brought to order arms. Then, accompanied by hand music, the reviewing officer and his party move forward to the commander of troops. The latter leads them around the soldiers in an inspection. This may take any form the reviewing officer desires but is never the detailed type of inspection previously described.

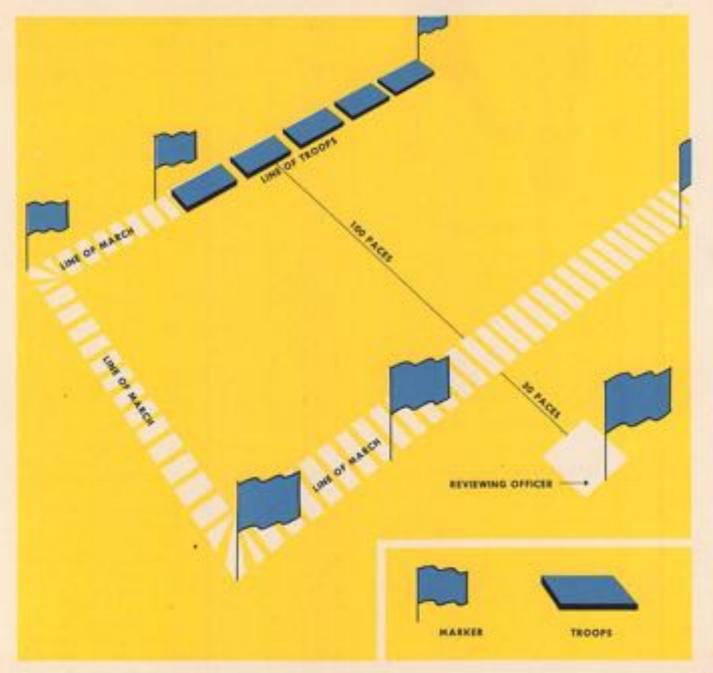
As the reviewing officer approaches each unit of the troops, its commander gives the order, "Eyes, right." At this, the men amartly turn their heads half right and follow the passage of the reviewing officer with their eyes and heads until he is directly in front of them. At this point they remain in the normal position of attention.

When the reviewing party has returned to its original place, the commander of troops commands, "Pass in review." Then begins the most dramatic part of the ceremony. Unit after unit moves off to its right, marches to the end of the field, turns, crosses it, turns again, and moves towards the opposite end of the parade ground past the reviewing officer.

As each company approaches the point immediately in front of him, its commander salutes or presents his saber while giving the order, "Eyes right." At this, the guidon bearer in front of each unit dips his guidon in a prescribed salute. Every man in the company, except those at the right end of each rank, simultaneously turns his head to the right until given the command, "Front." As soon as he hithself passed in review, the commanding officer of the troops left his place at the head of the column and spent the rest of the ceremony beside the reviewing officer. After the troops have marched by, he salutes that individual and rejoins his command.

In addition to honoring dignitaries, reviews of this sort are held when soldiers or flags are decorated.

At some posts, a Retreat Parade is held at least once a week. This is nearly as impressive as the ceremonial review except that the reviewing officer in that case does not inspect or pass around the troops.





HOW TO SPOT PLANES IN A FLASH

To shoot or not to shoot: that's the decision every combat pilot and every gunner has to make for himself in a split second. When a plane is racing towards you at 5 or 6 miles a minute, you have no time to figure out whether it is a friend or fee. You must recognize it instantly. You must know instinctively from thorough training whether to hold your fire or let it your. * When our country entered this war, mistakes in recognition were too numerous for health and comfort. Over in the Pacific area, while our contact with the enemy was still new, many of our P-40's were mistaken for Zeros and shot down by other American fighters. But careful study of outstanding features of the two planes soon remedied that situation. * New we fully realize that the only way to prevent this kind of mistake is to demand the highest proficiency in aircraft recognition. You can begin right now to echieve that degree of skill. In this section of your manual you will become acquainted with more than a score of outstanding American airplanes. Build from this essential beginning until you become completely familiar with all military aircraft. Then if you ever become a member of the Air Forces, there will never be a question of your recognizing a plane-friend or fee-in the eir.



IN THIS SECTION ...

Introduction

Recognizing on Airplane by Its Overall Appearance...How to Advieve Speed in Recognition...Three Stages of Learning to Identify Planes Instantly and Positively...Hints Helpful to Speedy Recognition: Principal Differences between Land and Sea Planes; Number of Engines, Position of Wings...WEFT System of Checking Outstanding Features...Importance of Knowing How Wings Look from Any Angle........How an Engine's Type Affects its Appearance...Variations in Fuselage.........Variations of Tails

Best Ways to Practice Recognition

The 3-View Silhouette....Making the Most of Photographs....What You Can Learn from Models.... Warning: Beware of False Impressional....What Sillographs Are......Sketch Books.....Making is Set of Flash Cards

Silhouettes

Check Points, Factual Highlights, and Views of: P-38 (Lightning)—P-39 (Aircrobne)—P-40 (Werhawk)—P-47 (Thunderbolt)—P-51 (Mustang)—A-20 (Maroc)—A-29 (Hudson)—8-34 (Ventura)—8-25 (Mitchell)—8-26 (Marauder)—8-17 (Flying Fortress)—8-24 (Liberator)—C-46 (Communde)—C-47 (Skytrain)—C-54 (Skymaster)—L-4 (Grosshapper)—S82C (Helidiver)—F4F (Wildcot)—F4U (Consoir)—F6F (Helicon)—S8D (A-24) (Doseitless)—P8Y (Consolno)—P8M (Meriner)—P82Y (Consolno)

Letter Designations of U.S. Aircraft

How Army Aircraft Are Designated...Table of Letter Symbols for Various Types and Classifications... How Navy Aircraft Are Designated...Table of Letter Symbols Identifying Types

Sillographs

Key to Sillographs on Page 3-19-Key to Sillographs Throughout Manual



How can you learn to know instantly that a day moving outline in the say is a P-38 or a B-27 or a C-54? Well, look at it this way. When you used to watch autos racing by on the highway at 60 miles an hour, did you stop to examinite very feature of every car to know what it was? Did you go thoough a long process of analysis to decide that it was a Packard or a Ford or a Pierce-Arrow? Of course not. Your recognition was instinctive. You had seen it a many times in the past that you knew every feature of it at the quickest possible glance.

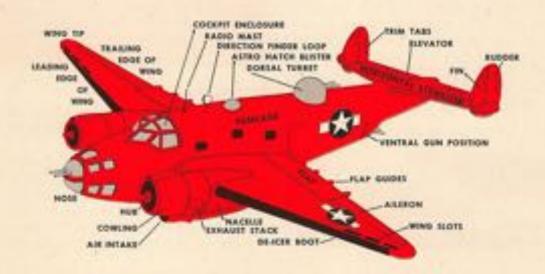
Translate this into terms of aircraft, and you can see that the most important thing about recognizing a plane is to be completely familiar with it. Then you don't have to analyze it feature by feature. Your eye takes in all the necessary details at a glance. You recognize the aircraft instantly by its everall appearance, or total form, and know it positively.

Recognition Must Be Regis

Speed comes from being absolutely sure of yourself in recognizing an airclane. If you're only partly familiar with it, you have to guess. The result is hesitancy and inaccuracy, and you know what that means in combat!

Easis plane has characteristics that make it a personality. Learn all you can about the different planes. Get to know them as well as you know the different automobiles you see on the street.

Practical results are the final test. Try your skill on every actual airplane you see in the air. Test yourself and your friends on every reproduction of one, in the newspapers, magazines, or newsreels. Make your slogan: Eyes Aloft!



Your Progress in Recognition

As a student, you will pass through several interesting stages of instruction. Soak up all the information you can. It will pay off handsome dividends in your future flying career.

- 1. The first thing to do is to learn the language of flyers. What are the parts of the plane? Where are they? What are their technical names? What do they do? When you have the answers, you know the important details about planes in general.
- With this knowledge well stowed away, you now learn the shapes of individual aircraft. Analysis by parts is still handy. But more and more you see that each plane has an overall appearance, and less and less do you analyze it bit by bit.
- 3. Now you are completely familiar with the different planes. At this point, the whole business of recognition begins to appear pretty easy. You are concerned with the whole plane, and study parts only in their relation to its overall appearance. You are now entering the expert class.

You can always improve on your recognition. Strive for greater speed, greater accuracy. Study the new planes. New designs are always coming in. Get to know them-practice on them. Make this your standard of perfection: "I shall learn to recognize aircraft at the greatest possible range in the quickest possible time!"

Your Recognition Technique

Any system you work out for recognizing planes is fine, so long as it pays off. But here are a few good hints on how to spot planes quickly:

Learn right away to differentiate between land and sea models. The land plane has wheels, which are retracted in flight (except in the case of a few planes, when they are plainly visible in the air). The seaplane either has pontoons, which are too bulky to be retracted and stick out below the fuselage, or a large, hull-bottomed fuselage. If it has the latter, it is of the flying boot design. A few scaplanes are amphibious: They have both pontoons and wheels, so that they can let down on sea or land.



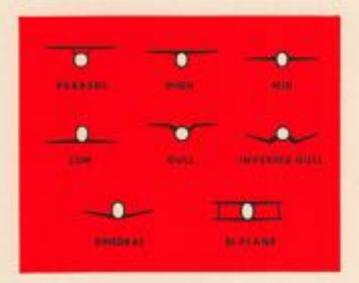
Number of Engines

Here is a good aid to recognition, quick to spot. How many engines does the plane have? Single engine planes are usually fighters, dive-bombers, or light attack ships. Twin engine planes, though sometimes fighters like the P-38, are generally transports or medium bombers. Four-engine ships are heavy bombers and huge transports.



Position of Wings

There is another easy general way to classify planes for spotting. Look for the parasol wing, the high wing, the middle wing, or the low wing position. Associate its wing position with each plane's personality.



Learning the Individual Plane

Once you have learned general characteristics, get right down to the business of knowing the details of individual planes.

At this point, make some sort of orderly plan to check over the outstanding features of a plane. That's the advantage of using the so-called WEFT System checking, in order, by Wing, Engine, Fuselage, Tail.

Always remember, however, that this WEFT plan is only to help you analyze the planes. The firm foundation of knowledge it provides leads to our final goal of spotting planes in the air by their overall appearance.



Wings

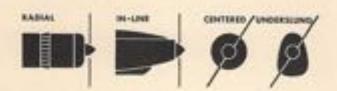
Officially, the plan shape of the wing is the way it looks to you when the plane is directly overhead. But by testing yourself at every opportunity, get to know the way the wing looks no matter what angle the plane is coming from.

Know the position of the wings. Notice the way they are attached to the fuselage. Do they extend straight outward, or upward at a slight dihedral, or do they have some unusual appearance? Look for any small peculiarities and store them away in your spotter-memory.



Engines

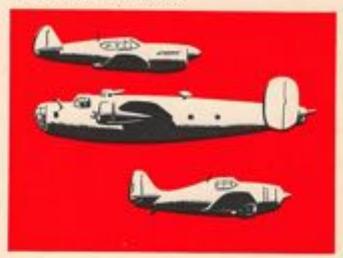
You have already learned to check the number of engines on a plane. Now look for the difference in type of engine. Is it air-cooled radial or is it liquid-cooled in-line? Notice how the radial type has a round, snub, broad surface. Contrast that with the pointed, streamlined appearance of the in-line engine. See how the engine is along in different positions on different planes—sometimes underslung, sometimes centered, sometimes overslung.



FuseInge

The fuselage may look like anything from a cigar to a barrel. Fighters, as a class, have a slim, short fuselage in contrast to the massive, bulky fuselage of the bombers. Sticking out in front of the wings in the fuselage nose, which often has characteristic features.

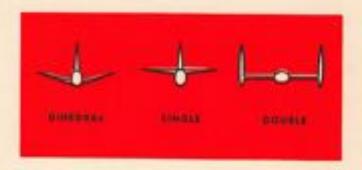
Some planes, like the P-38 and P-61, have twin booms joined by a common horizontal stabilizer. Gun blisters on top, underneath, or on the sides are also handy recognition features.



. Tail

Single engine planes generally have single fin and rudder. So do most multi-engine aircraft, but some of them have twin fins attached near the ends of the horizontal stabilizer. There is a feature you can spot in a flash.

The shape of the horizontal stabilizer varies just as the wing plan does, and it's a wise student who studies his silhouettes and photographs for this feature. The same goes for the rudder and especially for the fin. In fact, the tail assembly as a whole is so important that it often provides the chief clue to absolute recognition of a plane!





Illustrations of active Army and Navy combat planes appear in the following pages. Study these photographs and silhouettes carefully and you'll be well on your way to being an expert observer of U. S. combat aircraft.

Make good friends with the silhouettes. They're mighty important to know. In fact, silhouettes are the foundation of all recognition training.

The "3-view" silhouette gives the head-en aspect, plan, and side view. It shows every important recognition feature of a plane, just as an architect's drawing gives the essentials of a building. Take a look at the silhouettes of two planes and notice how sharp the contrast is, how easily you can tell the difference between them.





Study the photographs. These are closer to the way the planes actually look in flight. Go over them until you can spot every distinguishing feature. Be an expert! Concentrate on the pictures that show planes at a distance.



Models

Spend all the time you can with airplane models. Try your hand at making them. Some of the finest combat pilots we have were the fellows who were building and flying models when they were in high achool.

Study every model you can lay your hands on. Notice the proportions. Check through your knowledge for every outstanding detail.

PREPARE YOURSELF FOR THE REAL TEST

Always bear in mind that the actual spotting of aircraft consists of recognizing a distant moving object in the sky that is constantly changing appearance. Watch out for this! Practice with models and with model shadows thrown on a screen. Keep these moving and notice the changes.

One of the most disturbing factors in recognition is the fact that perspective gives you false impressions. Here's an example: The Army's chief transport, the C-47, has wings with a marked dihedral. It has a very pronounced taper on the leading edge and a straight trailing edge. In plan view, this wing is one of the chief recognition points of the plane.



However, when you see the C-47 from below coming at you, perspective causes the wing to appear swept forward. The leading edge seems almost straight, while the taper seems to be on the trailing edge. Thus the plan form of the wing is just reversed.



Remember: When seen from below (front or rear), a wing with a marked dihedral appears to be bent towards you. When seen from where, it seems to be twept away from you.

Sketch 'em and Know 'em



Every time you study a plane, try sketching it on paper. You don't have to be an artist. Just draw as well as you can. The important thing is to get the main features down on paper. You'll remember them a lot better that way.



Build yourself a set of flash cards. Get pocket size cards and paste a photo of a plane on each one. Cut the pictures out of papers, magazines, booklets. (But please don't cut up this manual.) Test yourself for speed and accuracy, challenge the students around you. Make a war game out of it, and see if you can't be the victor.



Highlights

The P-38 has speed, range, and excellent high altitude performance. Above all, it is a versatile plane. In the Alcutians, in the South Pacific, in Europe, and in North Africa, it has been used both as a low and high altitude fighter and as a photo reconnaissance plane (in latter case, designated as F-4 and F-5). The fact that its peops rotate in opposite directions, thus bolancing torque, enhances its maneuverability. With its twin tail booms, the Lightning is one of the easiest planes to recognize.

Highlights

This airplane, one of the most graceful in the air today, often mounts a 27-mm. cannon, the heaviest carried by any airplane of similar type. The P-39 has been used effectively for ground strafing, and as a low altitude fighter. Heavy defensive armor protects the pilot against ground fire when operating at low altitudes. The engine is placed amidship in the fuselage behind the pilot's cockpit, the propeller being driven by a 10-foot shaft.





engines. « Air scenps on twin bosons. « Twin firs. ». Tail place

extends beyond the redders



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plane graceful recker effect

P-40 "Warhawk"



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Highlights

This is one of the best known and most widely used American fighters. Earlier models, called "Tomahawks" and "Kittyhawks" by the British, were used in Libya, on the Russian front, and by the "Flying Tigers" in China. The Warhawk is the first American airplane to be equipped with the famous Merlin engine. This fighter has excellent armor, high diving speed, good maneuverability, and beavy hitting power. Although the P-40 is not at its best in higher altitudes, it is one of the most versatile of planes.

P-47 "Thunderbolt"



CHECK of Radial engine of Oval-phopod court—peop hash above center of Stubby using with full dihedral of Thick fusalege, with sharp ridge down sloping back.

Highlights

The P-47 is one of the largest and fastest single engine fighters yet built. Its weight of over 5 tons, with nearly a ton of guns and ammunition, is greater than that of many commercial transports of a few years ago. Designed in 1941, this is the highest horsepower single engine fighter yet produced for the Army Air Forces. Use of a 4-blade propeller reduces the size of the propeller arc, while still coping with the engine's great power output. This airplane was designed for fighting at high altitudes.





Highlights

The Mustang was developed quietly and attracted little public notice until the British used it in the dramatic Commando raid on Dieppe. Since then it has been used extensively on fighter sweeps over Europe, on reconnaissance missions, on all kinds of low-level strafing and attack jobs. It is exceptionally fast. One P-51 crossed the U. S. in 6½ hours. An outstanding virtue is its speed near the ground. A bomber version fitted with dive brakes, the A-36, is now in service for ground-air support.

Highlights

This airplane is unquestionably one of the best in its class. Designed as a fast day bomber, it is also used as a fighter. The night fighter version with solid nose is called the P-70, while the British know the A-20 as the "Boston" when used as a bomber and as the "Havoe" when used for ground attack. The U. S. Navy designation is BD. The A-20 is much used in large scale daylight fighter and bomber sweeps over France and was so used in North Africa. Because of its high performance, striking power and maneuverability, losses have been relatively small.



P-51 "Mustang"



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A-20 "Havoc"



CHECK of full-engines, radial, understong of Huselins project wolf beyond trailing edge of Long thin noise of Fuselege based up toward room of Yory tell radials:

A-29 "Hudson"



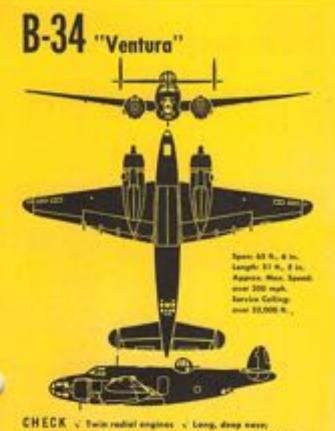


CHECK . Twin regimes . Full diberhal . Long. deep name . Fewler flep tracks . Open twin flee and redders and inhered



Highlights

The British have a special name for this medium bomber. During the Battle of Britain they christened it 'Old Boomerang," because "it always comes back." A-29's used to range out over the Channel, spotting approaching Nazi bombers in time to signal Spitfires and Hurricanes into the air to meet them. The "Hudson" was first flown in 1939 and was developed from a commercial transport. Still in use, sharing service with the newer, bigger "Venturas," it was the first American-built type which Ferry Command pilots flew across the Atlantic to England.



deep fundings. v. Shorply topored wing, with steep dileated v. Fawler flep tracks. v. Esp turns, small ventral speed

v. Twin firs, mounted inhoused

Highlights

The Ventura was developed from the Hudson (A-29) which it closely resembles in size and appearance. The Lodestar (C-60) transport plane belongs to the same group and is practically identical except for armament. The Ventura is slightly heavier than these ships and has much more powerful engines. The RAF Coastal Command has used it, along with the A-29, for general reconnaissance and other duties.





Highlights

The B-25 was named for the late Gen. "Billy" Mitchell. It has gained considerable publicity as the result of the bembing raid on Tokyo in April 1942. It is in use on nearly all of the Allied war fronts and performed well for the British in their African campaigns. The Mitchell was the first to use 75 mm, cannon, and has proven itself highly effective for tree-top or mast-high bembing.

Highlights

No Axis airplane of the same class matches the B-26 for speed, range, or bomb-carrying capacity. In the Battle of Midway, it was used as a torpedo bomber. This was the first time that land-based torpedo bombers of the U. S. Army had been put in action. Over North Africa and Europe, the Marauder has proven itself a hard-bitting bomber.

The design for this airplane was completely new, owing little to any previous conception. The earlier models had a wing span of 65 feet.







for about at leading edge. . Wing and tail place similar in shape,

. High rounded redder v Boer fundage ands in paint beyond tell

but wing is straight while tail plans has marked dihedral

B-17 "Flying Fortress"



CHECK . Four engines . Long reland cobin, with gun turned att of pilot . Ball turner, tail turnet . Wide helf plane chaped like using .; Long, very high fin

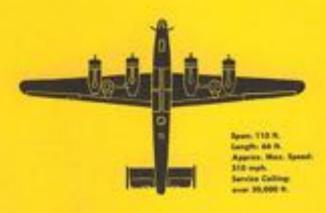


Highlights

The B-17 was the first long-range American bomber. It was designed for high altitude, daytime precision bombing. Intended primarily for long flights over the Pacific, great fuel capacity rather than tremendous bomb load was emphasized in the original design. But the B-17 has been used as a heavy carrier of bombs to be unloaded on Europe. In addition, it has done effective work in raids at shorter range. It is a heavily-agmored, well-gunned ship. The latest models have a chin turret to protect what was formerly a vulnerable spot on the plane.

B-24 "Liberator"







CHECK of Payer radial angines of Long, narrow, toperad wings of Deep, bulky funcings of Tarin fine, large and recorded

Highlights

This long-range bomber is used in all theaters by the British and the U. S. Army Air Forces. It has high speed, powerful armament and is extremely maneuverable for its size. All of these factors reduce the number of fighter craft needed to protect it. The B-24's high performance results in part from its clean design and use of the thin "Davis" wing which materially reduces drag. The military transport version, called the C-87, has a non-transparent nose, and a cabin under the wing in place of the bomb bay.





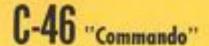
Highlights

The largest twin engined military cargo plane in the world, the Commando is sometimes called the "Flying Whale" or the "Troopship of the Sky." Originally designed as a 36-passenger commercial airliner, it frequently carries such materials as trucks, light field artillery or "Jeeps." Adapted for troop carrying in 1941, it transports a large number of fully-equipped troops. The Commando's engines are larger and more powerful than those in use on commercial airlines, and in size this airplane dwarfs commercial craft.

Highlights

This troop and cargo transport is the military version of the DC-3, one of the best known and most widely used American commercial planes. It has done magnificent service in every quarter of the globe. It is used as a standard transport (designated PS-84) of the Russian Air Force. This plane is either a C-47 ("Skytrain") or a C-53 ("Skytrooper"), depending on whether it is arranged to carry cargo or paratroopers. The name "Skytrain" comes from use of this transport as a troop carrier and as a glider tug.







CHECK of Twin redict angines, projecting wan forward of "Fut ciper" feedings, pointed noise of High round fin of Mings reported on outer penels, mainly on leading edge



Swept-back leading edge, sheight trailing edge
High Se, with long extension on fundage
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shape of noon and solds

C-54 "Skymaster"



CHECK < Four radial angines < Nerrow, equally topered wings, with small reunded tips < Long, sireafer functions < Long soon < Tall fin

Highlights

This troop and cargo carrier is the largest operational military transport in the United States today. Its commercial designation was DC-4, the prototype of which was sold to Japan. The current military version differs in many ways, however, from the plane which the Japanese purchased. When it is in use as a troop transport, the Skymaster can carry more than 40 fully equipped soldiers.

L-4 "Grasshopper"



Spore 38 ft. Sength: 29 ft. Approx. Spends FS-78 maph.



CHECK of High wing of Square using edges, rounded tips of Neurostrustubils landling great of Mone atlahing out like degits arrest

Highlights

The military version of the widely-used Piper Cub, this 65 hp. L-4 carries personnel, drops messages and supplies, and spots targets for field artillery units. The L-4 made military headlines when it landed Gen. Mark Clark in the Main Street of Naples, in front of the post office. An ambulance version of the L-4 lands close to the battlefront. Its short take-off allows the evacuation of urgent casualties. The Grasshopper is totally unarmed. Nevertheless, it has an unusual front-line safety record, achieved by flying low so its camouflage blends with the terrain.





Highlights

One of the largest operational single engine airplanes, the Heildiver carries torpedoes, depth charges, or large bombs. It operates either from carriers or from land bases. It is faster, and probably carries larger bomb loads than the German "Stuka." Some models of this airplane appear with twin floats. From all indications, the SB2C is one of the world's deadliest dive bombers.

Highlights

This fighter, called the "Martlet" by the British, can be based either on carriers or on land. It is an excellent airplane and was probably the best carrier-based fighter in battle service until the coming of the newer, heavier, and faster Corsair which is now gradually replacing it. The Wildcat has shown altitude performance approaching that of the Zero. The Marines used this plane on Wake Island. Lt. Commander O'Hare was flying one when he shot down 5 Japa during a single operation.



SB2C "Helldiver"



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F4F "Wildcat"



CHECK of Redist regime of Diseased from using reads of Square using tips and tell group of Deep feedings, with high bumped back

F4U "Corsair" Special II. Longhy 23 R. 4 In. Approx. Max. Special Met mah. Service Calling aver 24,000 ft.

CHECK & Radial region, blant cone & Inverted gull using & Raund using tips & Small recipit, amidships & Radder and forward, furnings tip projecting



Highlights

This is one of the fastest ship-borne fighters in operation today. The large inverted gull wing was designed to give added clearance for the long propeller blades required to absorb the output of the F4U's 2000 hp. engine. The lower wing position of gull design also increases the air cushion effect between deck and plane during landing.



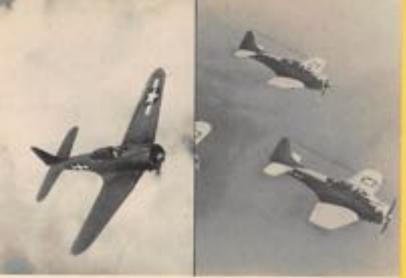


CHECK of Redist engine of Sharp dihedral break of Deep stubbly functions of High nervow cockpit, with straight line renning down to fin. of "Squarkhi" wing tipe

Highlights

One of the few airplanes designed and put into operation since the war began, the Helicat has been called the "answer to a fighter pilot's prayer." Its performance is similar in many respects to that of the Corsair. It is larger than the Wildcut and its landing gear retracts into the wing.





Highlights

This excellent dive bomber is one of the longest lived of all combat aircraft. It has seen much action from carriers of the U. S. Navy in the Pacific, notably in the Coral Sea Battle and at Midway. Long considered to be the finest carrier-based dive bomber in the world, it is now excelled in some respects by the more recently developed Helldiver. As the A-D4, the Dauntless is the first dive bomber which the U. S. Army used in quantity to support ground troops. It carries a 1,000-lb, bomb in a cradle under center section, and there are bomb racks under wing roots.

Highlights

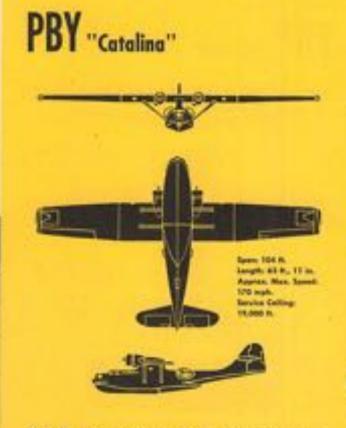
A "Cat" spotted the German battleship "Bismarck" after the sinking of the British battleship "Hood." Its capacity to stay long hours in the air makes this airplane ideally suited for long sub-spotting and convoy-guarding patrols. In the Aleutians and Solomona, the PBY is reported to have been used as a torpedo bomber, carrying 2 torpedoes under the wing. Alternatively, it can carry eight 325-lb. depth charges or two 2,000-lb. bombs under the wing. The Catalina is built under license in Russia with some modification. The Russian designation for it is GST.





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CHECK of Twin engines of High, paraset-typed wing, braced by struts of Wing-tip Reers, remediable of Twn large billion turnets behind wing of High tall of Peculiar shape of ness and hull

PBM "Mariner"



CHECK of Twin angines of High "gulf" wings of Twin Sex.
"Speed in," with disturbed half plane of Big half, topming back
with sharp step on under side of Two small postnores

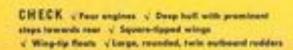


Highlights

The Mariner is an extremely serviceable long-range flying boat. It gives excellent results over rough seas and under otherwise strenuous operating conditions. This airplane was first designed, built, and flown in miniature. It carried 2 torpedoes or equivalent weight in bombs under the wings inheard of the engines. On the PBM-3, fixed wing floats have replaced the retractable floats of the 2 previous models. At present, some Mariners are being used for over-water transport. The latest model, PBM-3C (not shown here), has 3 power-driven turrets.

PB2Y "Coronado" High





Highlights

The "Coronado" is a seaplane of great size, power, and range. The Navy uses it principally as a patrol bomber. In many instances, however, it has been converted for transport purposes. In the latter case, it is called the PB2Y-3R. The transport version has gun positions removed and fuselage faired in. The wing-tip floats are retractable. The "Coronado's" twin fins and rudders are practically identical with those of the Army's B-24.



Letter Designations of U.S. Aircraft

ARMY

NAVY

Army aircraft are designated as follows: one or two letters denote the class of aircraft; a number indicates the model; and a letter shows the modification of the model.

For example, the designation B-17F means the airplane is a bomber (B), that it is the 17th bomber model accepted by the Army, and that it is the 6th modification of the B-17 model. Unlike Navy aircraft designations, the Army gives no information as to the identity of the manufacturer.

OA Amphibion

F Army Reconntinance (Photographic)

A Bembardment (Light)

B Bombardment (Medium and Heavy)

PFighter

L Ligison

O Observation

AT Training (Advanced)

BT Training (Besic)

PT Training (Primary)

C Transport (Cargo and Personnel)

UC Utility Transport (less than 9 places

or 1,400 lbs. of corpo)

CG Glider (Troop)

TG Glider (Training)

CQ Target (Control)

OQ Target (Aerial)

PQ Target (Aerial)

Classifications are prefixed as follows:

R Restricted (Planes no lenger considered

first line aircraft)

XExperimental

Y Service Test

Z Obsolete

Navy aircraft, airships, and gliders are designated as follows; one or two letters show the class of aireraft; a number indicates the model; a letter indicates the manufacturer; and a number designates the modification of the model.

For example, the first patrol bombing plane to be produced by Consolidated Aircraft was the PBY-1. The modifications to this airplane were PBY-2, PBY-3, etc. The second patrol bombing plane was the PB2Y-1 and successive modifications were numbered in order. The prefix letter "X" is used for experimental aircraft and gliders.

HAmbulance

B Bombing

F Fighting

O Observation

PPatrol

\$Scouting

T Torpedo

OS Observation-Scouting

N Training

R Transport (multi-engine)

G Transport (single engine)

J Utility

BT Bombing Torpedo

PS Patrol Bombing

SB Scouting-Bombing

JR Utility-Transport

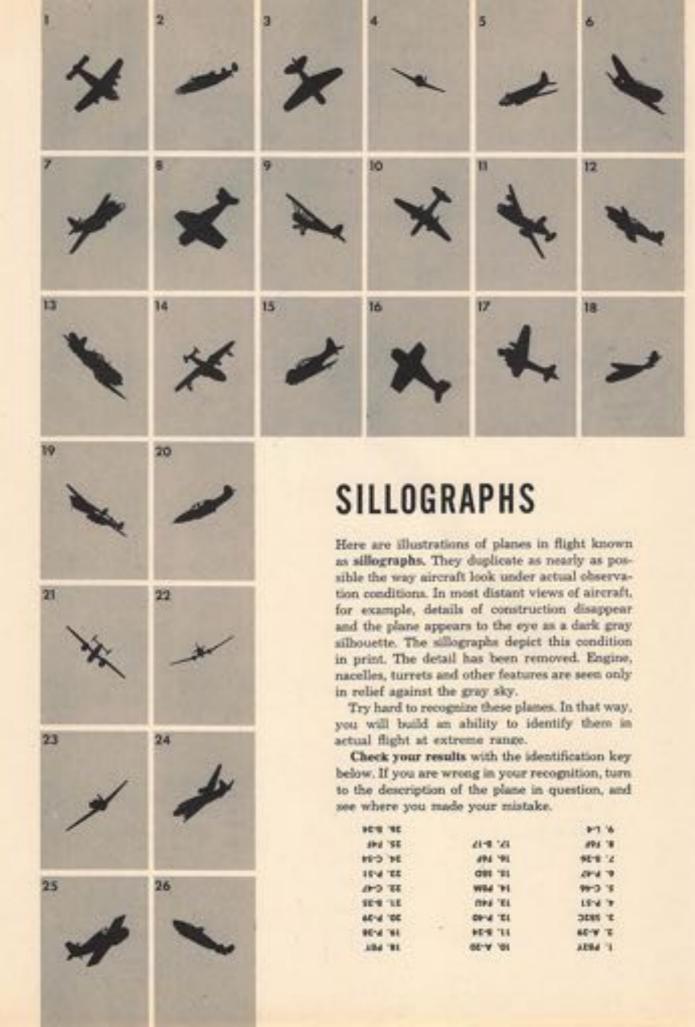
L Glider

ZN Airship (non-rigid)

SO Scouting-Observation

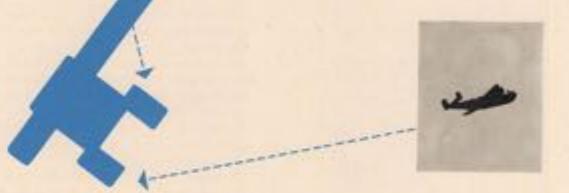
SN Scout Treining

TB Terpede-Bombing





THROUGHOUT THIS MANUAL



1. P-38	9. 8-34
2. P82Y	10. 582C
3. P-40	11. A-20
4. SBD (A-24)	12. F6F
5. P-39	13. P-51
6. PBM	14. F4U
7. P-47	15. A-29
s PRY	16 F4F

17.	8-17
18.	1-4
19.	B-25
20.	C-54
21.	B-26
22.	C-46
23.	B-24



GETTING IN SHAPE TO FLY

The best airplane in the world is only as good as the man who flies it. His strength, speed, power, and endurance must be commensurate with that of his ship. He must be able to fly at high altitudes for long hours. He must be able to stand the gruelling strain of prolonged anti-aircraft fire and frequent dogfights. He'll be more likely to come safely through a crash landing or to survive a serious accident if his physical stamina is great. * Knee-bends and pushups may seem unlikely to produce these necessary results. But they and other carefully selected physical exercises are responsible to a large degree for the superb condition of American flyers today. Their strengthened abdominal muscles increase their ability to avoid blacking out. Their trained hearts supply more blood and oxygen to the tissues than do untrained hearts, when they are subjected to physical stress or when there is a lower percentage of axygen in the air. * Regular participation in a sensible, well-planned program of physical education is one of the most important ways to achieve such fitness. The calisthenics, combat games, carries, and group games described or suggested in the following pages will help improve your strength and endurance.



IN THIS SECTION ...

Introduction

Four Groups of Exercises Which Should Be Included in Every Regular Physical Training Program— Suggested Variations—When to Take Physical Training—What to Do Immediately Afterwards— Benefits of Planned Exercise

Calisthenics

What Warm-Up Exercises Are... Descriptions of 5 Suggested Calisthenics: The High Jumper, Squat Bender, Situps; Bank Twist; 8-Count Pushups.

Dual Exercises and Combat Games

Descriptions of: Straddle Fullups; Fall and Roll...-Value of Combat Games...-Descriptions of: Hand Wrestling; Indian Wrestling; Rooster Fight...-Why Wrestling Is Valuable.

Carries

For Men: Arm Carry; Fireman's Carry; Cross Carry; Single Shoolder Carry—For Girls: 2-Mon Carry; 3-Mon Lift; Carrying Victim by Extremities.

Swimming and Running; Group Games

Kinds of Running a Physical Training Program Should Include -- Seven Objectives to Master in Swimming--- Value of Group Athletics--- Eight Suggested Group Games.







You should devote an hour a day to physical training, which should include 4 groups of exercises:

- 1. Calisthenies.
- Dual Exercises, including Combat Games and Carries.
- 3. Swimming and Running.
- 4. Recreational Athletics and Group Games.

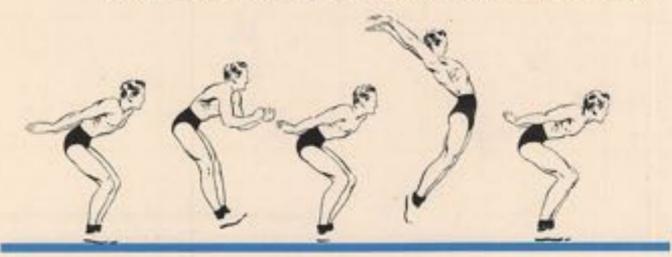
Devote half of the physical training period to vigorous group athletics, and on alternate days, to swimming or running. By varying the exercises from day to day, you will find them interesting as well as valuable.

If possible, take your physical training at least 2 hours after a meal and at least 30 minutes before your next meal. Don't drink water during or immediately after exercise. Remove most of your clothing during exercise and add clothing afterwards. If possible, take a shower immediately.

Physical fitness is as important for girls and women, if they are to take an active and useful part in aviation activities, as it is for beys and men. Planned exercise will improve their muscular tone and posture, increase their resistance, improve their stamina, relieve tension, and improve their coordination. Women will teach the physical training program for girls and it will not be as strenuous as the boys' program. Some of the exercises for boys, however, can be used to equal advantage by girls.

Calisthenics

Simple warm-up exercises should precede collisthenies. These warm-up exercises consist of raising the arms forward, sideward, and overhead; bending forward and touching tees; and hending the head forward, backward, and side to side. Then do the following collisthenies energetically. Increase daily the number of times you do each one. You will find descriptions of additional collisthenies, which may be used as oftenates, in the pamphlet "Physical Conditioning Based on War Department Training Circular 87."



1. The High Jumper

This is a warm-up exercise, which involves the entire body and develops coordination. Start with feet spread about 12 inches, knees slightly bent, arms raised backward, body bent slightly forward at the waist. Do the exercise at a fairly slow count (cadence). and in 4 movements:

- a. Swing arms forward and jump upward.
- b. Swing arms backward and jump upward.
- e. Swing arms forward over head vigorously and leap upward at least 12 inches.
 - d. Swing arms backward and jump upward.



2. Squat Bender

This is an excellent exercise for the legs, thighs, and trunk muscles. Start with feet slightly separated and arms in thrust position. Do the following 4 movements in moderate codence:

- a. Do a full squat and thrust arms forward, with fingers extended, palms down, trunk erect.
 - b. Return to original position.
- Bend forward sharply. Touch toes, keeping knees straight.
 - d. Return to starting position.



3. Situps

This exercise strengthens the muscles of the abdomen, thighs, and hips, and stretches the calf muscles. Begin by lying flat on your back, feet apart, arms extended overhead. In slow cadence, do the exercise in 4 movements:

- a. Sitting up, thrust arms forward and touch toes, keeping knees straight.
 - b. Lie back to original position.
- c. Raise legs, swinging them back overhead, and touch toes to ground, keeping knees straight.
 - d. Lower legs slowly to starting position.



4. Bank Twist

This exercise strengthens the hip muscles and the oblique muscles of the abdomen. Lie flat on your back, arms extended sideward, palms down, legs raised to a right angle, with knees straight, feet together. Do the exercise in 4 movements in slow cadence:

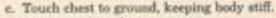
- a. Lower legs to the left. Twisting body and keeping knees straight, touch ground with feet.
 - b. Return to starting position.
- c. Lower legs to the right. Twisting body and keeping knees straight, touch ground with feet.
 - d. Return to starting position.



s. Eight-Count Pushups

This is an excellent exercise for the muscles of the arms, shoulders, trunk, and legs. It is performed in 8 movements, in moderate cadence, Beginning from the position of attention:

- a. Bend sharply at the knees and slightly at the hips and place the hands in front of the feet in squat. position.
- b. Thrust feet and legs backwards to a front leaning position, with the body straight from shoulders to feet, weight supported on hands and toes.



- d. Return to front leaning position.
- e. Touch chest to ground again, keeping body stiff.
- f. Return to front leaning position.
- g. Return to squatting position.
- h. Return to position of attention









xercises and

1. Straddle Pullups

This exercise strengthens the arm and shoulder muscles. In the starting position, one man lies flat on his back, with arms stretched upward (palms facing away from him). Another stands astride his shoulders and grasps his outstretched arms. Do the exercise in 2 movements, in moderate cadence:

Keeping body straight from shoulders to heels,

and supporting weight on heels, the person lying down pulls himself up as high as possible, keeping his fingers hooked into the palms and fingers of the person standing over him. (Note: It is important to have your fingernails trimmed close for this exercise to prevent cutting your partner's fingers.)

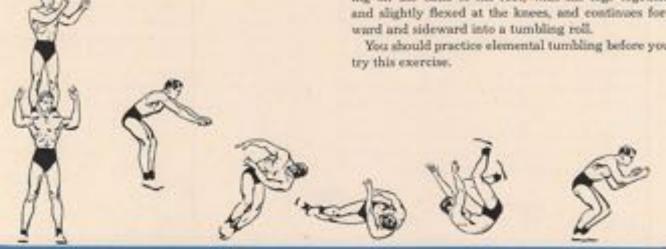
b. He then slowly lowers himself to the ground, keeping his body straight. After several pullups, reverse positions.

2. Fall and Roll

This exercise is of great practical importance to all flyers, because it shows the best way to land after a parachute escape. This exercise should be performed on soft turf or mats for safety. The 2 men face each other, with hands joined and arms crossed. The bottom man places his left leg forward and bends his

knees. The top man places his left foot on the left. thigh of the bottom man and steps up, placing his right foot on the right shoulder of the bottom man and his left foot on the left shoulder. The bottom man releases hands and places his hands behind the knees of the top man. The top man balances himself in this position. At a signal, he leans forward and falls, landing on the balls of his feet, with his legs together and slightly flexed at the knees, and continues forward and sideward into a tumbling roll.

You should practice elemental tumbling before you



Combat Games

For the following exercises and for Combat Games and Carries, divide up into pairs, choosing a partner about your size and weight.

These contests are valuable in developing the ability to react instantly with a maximum of energy for the purpose of avercoming an appearant.



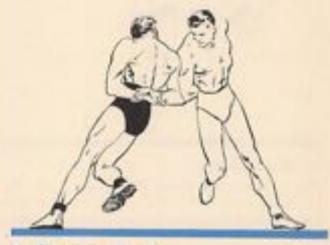
r. Hand Wrestling

Opponents face each other, clasp right hands, and place their right feet together, outsides touching. At a signal, each attempts by pulling, pushing, by sideward movement, or other maneuvering, to force opponent to move one or both feet from original position. Change hands (and feet) after each bout.

2. Indian Wrestling

Contestants lie flat on backs alongside each other, with heads in opposite directions. Link right elbows. At a signal, raise right leg far enough to engage leg of opponent. Do this 3 times rhythmically. On the third time, attempt to roll opponent over backward. After 3 bouts, change sides and use left arm and leg-





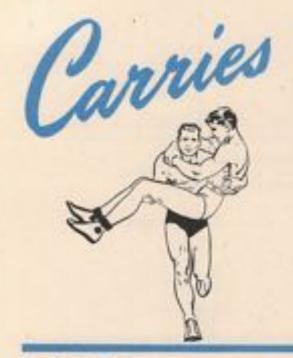
s. Rooster Fight

Hop on left foot, with arms folded across the chest. Use the right shoulder and right side of chest to butt opponent. The object is to make opponent lose his balance and fall, or to unfold his arms, or to touch his free foot to the ground.

4. Wrestling

This is one of the most valuable forms of exercise for combative activity. It develops all the muscles of the body.





FOR MEN. The importance of mastering these carries cannot be exaggerated. In addition to the exercise that they provide, the carries will enable you to perform important recove work and to transport wounded or unconscious persons.



1. Arm Carry

One, standing and facing Two's side, bends his knees, leans forward and places one arm behind Two's back and one arm under Two's knees. One straightens up, lifting Two from the ground. Two places his arms around One's shoulder and clasps hands. One then runs forward 30 to 60 paces.

2. Fireman's Carry

One, standing sideways in front of Two, bends his knees, leans forward, and places one arm through Two's crotch. Two leans forward until he lies across One's shoulders. One straightens up, lifting Two off the ground. One, using the hand of the arm through Two's crotch, groups the wrist of Two's arm that is hanging over his shoulder. In this position, One runs forward 20 to 60 paces.



3. Cross Carry

One, standing sideways in front of Two, leans forward. Two bends forward until he is lying across the middle of One's back. One then places one arm around Two's knees and one arm around Two's shoulders and straightens up, lifting Two from the ground. One then runs forward 30 to 60 paces.

A. Single Shoulder Carry

One, standing in front of and facing Two, assumes a semi-squatting position. Two leans forward until he lies across One's left shoulder. One clasps his arms around Two's legs and straightens up, lifting Two from the ground. In this position, One runs forward 30 to 60 pages.



FOR GIRLS. The following contex are better suited for girls than one the 1-man cerries which are recommended for even. You should theroughly master these carries not only for their exercise value but for the valuable experience which they provide for first-oid and ressue work.



1. Two-Man Carry

The 2 bearers kneel at either side of victim and, with one hand, grasp each other's shoulders around the victim's back. With the other hand the bearers grasp each other's wrists under victim's thighs. Pushing up with their legs, they then rise slowly from the ground and carry victim 30 to 60 paces.



3. Carrying Victim by Extremities

Two bearers kneel at head and foot of victim. Bearer at the head places her arms under the victim's until she can clasp hands around victim's chest. Bearer at the feet places her hands under victim's knees. At a signal, bearers rise together by pushing up with their legs and carry the victim 30 to 60 paces.

2. Three-Man Lift

The 3 bearers kneel on one knee on the same side of the victim, who is flat on her back. The bearer at the shoulders puts one arm under victim's head, neck, and shoulders and the other arm under upper part of victim's back. The second bearer places one arm under victim's back and the other under victim's thighs. The third bearer places one arm under vic-



tim's knees and the other under her legs just above the ankles. At a signal, all 3 bearers lift together and place victim on their knees. Then the bearers rise together and carry victim in horizontal position for 30 to 60 paces by walking forward in step.



Swimming and Running

These activities are among the best of all conditioning exercises, and are as valuable to girls as they are to men. Include some running in the physical training program at least every other day. This may include dashes, relays, cross country, or obstacle course running.

Swimming is particularly valuable to all flyers because of the training it gives them for meeting emergencies, such as bailing out over water and ditching. In practicing swimming, you should master these objectives:

- 1. Stay affoat.
- 2. Swim under water.
- 3. Swim long distances without exhaustion.
- 4. Enter the water feet first without submerging.
- 5. Be at home in the water fully clothed.
- 6. Undress in deep water.
- Render assistance to another person in the water.
 For this purpose you should learn and use the Red Cross life-saving methods.



Group Games

Group athletics stimulate teamwork and a competitive spirit as well as provide a pleasant form of recreation. These games may include volley-ball, dodgeball, basketball, softball, touch football, soccer, speedball, and human tug-of-war. Every CAP cadet should learn to excel in at least 2 of these sports.



Military compaigns have failed, and a war could be last, because of inadequate communications. A properly arganized and operated communications system is the nerve center of any command. Today it provides our mighty armed forces with all-seeing eyes, incredibly acute ears, and a voice which will carry any desired distance. The military airman is helpless without it. And civilian flyers should become familiar with whatever communication facilities are at their disposal. Communications increase both the convenience and safety of their flights. * This section of your manual will acqueint you with all the principal means of communication used in military operations. It will introduce you to the International Morse Code and show you ways in which, by diligent practice, you can readily learn to send and receive messages in it. In the following pages you also will learn how to use the radiotelephone most effectively.

IN THIS SECTION ...

The Eyes, Ears, and Voice of The Commander

Importance of Communications...Vivid Examples of Their Use in Typical Mission...Types of Wire Communication...Radio Uses...Types of Visual Communication...When Used...Why and When Sound Communication is Used...The Message Center...Messager Communication...The Pigeon

International Morse Code

Laymen's Idea of Code...Not Difficult to Learn...Why Code is Superior to Voice....Proper Steps to Take in Learning it......Haw to Print What you Hear.

Lesson One: Correct Adjustment and Use of Key-How to Make Your Own Buzzer-The Dit Characters E, I, S, H.-Importance of Sound-Review of Dit Characters.

Lesson Two: Learning To Space—The Dah Characters T, M, O.—Exercise in Words.

Containing All Characters Learned—Characters A, N, D, U.—Exercises.

Lesson Three: Sounding Letters and How to Practice—Accuracy More Important Than Speed—Characters W, G, V, B—Word and Sentence Exercises—Characters of Similar Sound. Lesson Four: Characters R, K, F, L—Exercises in Words and Sentences.

Lesson Five: Letter Group Exercise... Characters J. P. X. Z... Word and Sentence Exercises.

Lesson Six: Correcting Bod Hobits—Exercise in Proper Formation of Letters—Characters
C, Y, Q—Word and Sentence Exercises.

Lesson Seven: Exercises in Sending and Receiving-Practicing Numerals.

Lesson Eight Review—Exercises Combining Alphabet and Numerals—Punctuation Marks—Exercises In Their Use.

Lesson Nine: When and How to Use Blinker Signals.

Radiotelephone Procedure

Need For Radio Discipline—Advantages of Radiotelegraph—Other Types of Radio
Communication—How to Talk—Explanation of Phonetic Alphabet—Example
Of Its Use—Numerals—How to State Army Time—Call Signs—Parts of Message—Sample
Message—Proper Way to Repeat Parts of Messages—Radio Language—Transmitting
To Stations in Groups—Checking Signal Strength—Two-Station Net—Sample
Conversation—Four-Station Net—Central Tower Procedure—Sample

THE EYES, EARS, AND VOICE OF THE COMMANDER

The vital necessity of communications not only in the Air Forces but in all types of military operations is vividly illustrated in the following incident:

A small Signal Corps detachment—part of the Allied invasion force which landed at Palermo, Sicily, at the start of the Italian campaign—soon found itself deep in enemy territory, isolated from friendly forces.

It occupied the crest of a hill commanding an unobstructed view, though its presence remained unknown to German and Italian forces.

Lowering his binoculars, an officer issued an order to an aide. That night, shortly after dusk, a runner slipped from the detachment's hiding place on the hill. He carried a coded message which reported the mobilization of an enemy tank force, apparently for a counter-offensive. The messenger had only 1 chance in 10 of completing his mission. If he got through, Allied artillery and planes would concentrate on the reported position within 12 hours.

The officer sent his message by runner because other means of communication were not feasible. Radio would give away his position. Visual signals would offer the same disadvantage even if they could be seen over the mountainous terrain. Pigeons were not available.

At an Allied airbase in North Africa, meantime, a medium bomber warmed up for takeoff. Crew members were in place, safety harnesses fastened. The pilot spoke into a microphone. He asked the control tower for takeoff instructions, then taxied onto the runway in response to a green light signal. Instructions were given by radio, and the craft roared down the runway. It circled the field once, and headed out over the blue Mediterranean. Its mission was strafing —its destination, Sicily. The plane came in low and fast over Palermo and headed for enemy territory, gunners alert for the first sign of the enemy. The first burst was directed at a column winding through a shallow ravine which skirted a hill. The line of men broke as 50 calibre machine gan bullets kicked up dust along the enemy route. The ship climbed out of the valley as the



enemy column passed beneath its belly. It circled the hill for another run.

The copilot and gunners scanned the green terrain

below. Suddenly a flash of sunlight from the hill caught the copilot's eye. He requested the pilot to circle the spot. Now, men were seen scurrying about a cleared place in the trees near the top of the hill. A panel revealing the ground unit's identity was hastily spread on the ground.

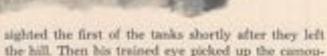
"They're Yanks, all right," the copilot reported. "Circle again, Joe-let's see what they want."

A second panel appeared as the plane passed over the clearing a third time. Consulting a chart, the copilot interpreted the single panel aloud:

"Reconneiter 25 miles in the direction to be indicated by the next display."

An arrow appeared on the ground on the fourth run, and the pilot dipped his wings to notify the signal unit below that he had received the message. The plane then headed in the direction indicated by the arrow.

The pilot lifted his ship's nose to gain altitude for a better view of the enemy territory. The copilot



"Boy, those Jerries are really gettin' ready for somethin' big!"

The copilot now asked the navigator for their position, and started to jot down a message. Completing it, he consulted a code reference, and wrote the message, this time in code. He then placed it in a special drop message container.

The plane headed back toward Palermo, and within minutes was over friendly troops. Spotting an American unit below, the copilot inserted a cartridge in the Very pistol, clamped it to the firing tube and pulled the trigger. A flare sprouted from the fuselage, notifying men below to be on the lookout. The message container arched earthward. The pilot circled once to make sure the container had been retrieved and, satisfying himself of this, headed again over the Mediterranean. The sun had disappeared and darkness soon overtook them.



Mid-way between Sicily and the African coast the right motor sputtered and died. The pilot manipulated the controls and got the craft back on an even keel. But the altimeter showed the plane was losing altitude fast.

The pilot ordered his radio operator to report the emergency, giving the plane's position. He then told crew members to gather emergency equipment, including radio, flares and Very pistol. The radio was the kind which could be operated by hand from the raft if the plane was forced to land on the water. The Very pistol would help attract passing friendly aircraft or ships.

Each erew member acknowledged the order through the plane's interphone system. The radio operator tapped out the message.

Struggling to maintain altitude, the pilot worked the dead engine switch frequently. Suddenly it took hold, sputtered, then picked up, and was soon working smoothly again. Pilot and copilot grinned their



relief. One of them told the radio operator to cancel the distress message.

The dark outline of the coast new loomed ahead. Thirty minutes later, a light signal from the home field control tower guided them in.

"Got your message," shouted the operations officer, as the crow stepped from the plane. "It was picked up at Bizerte and teletyped here. Message center telephoned it."

A messenger stepped forward, saluted, and addressed the pilot.

"You're wanted at Intelligence, sir."

The crew filed into the S-2 headquarters. An officer in shirt sleeves greeted the pilot:

"Nice work, Joe-your message got through okay. Artillery's already working on 'em, and we've just sent out a squadron to help soften 'em up. Good thing you spotted those tanks-probably saved the day for us-."

"Credit for that belongs to those Signal Corps guys on the hill," Joe broke in. Now that you've followed a typical mission, let's examine the different means of communications more closely.

WIRE COMMUNICATION



Primary means of conveying messages between points on the ground, its chief instruments are:

Telephone-Permits voice transmission quickly, and large volume of traffic.

Telegraph-Assures greater secrecy, and is not affected by weather conditions.

Teletype—Assures secrecy, speed, accuracy, handles large volume of traffic, and requires no skilled operator.

RADIO COMMUNICATION



This is the primary means of communicating between aircraft in flight, within aircraft (by interphone), and between aircraft and the ground.

VISUAL COMMUNICATION



Auxiliary means of communicating, supplementing wire and radio, are dependent upon character of warfare, proximity of enemy, character of terrain, and weather. Used when other means fail, usually as emergency means, their principal implements are: Panels, signal lamps (flashing airplane lights), flags, pyrotechnics, hand signals, airplane maneuvers, and mirrors.

SOUND COMMUNICATION



This means of communication is used primarily for alarms, attracting attention, and for transmission of short prearranged messages and orders. It should be used whenever such use is economical of time, personnel, or equipment, and only when making of sound will not disclose presence of troops to enemy. The chief instruments of sound communication are: Whistles, bugles, small arms, artillery, motors of airplanes in flight, horns, sirens, and rattles.

MESSAGE CENTER



This is the agency of the commander at each headquarters or command post delegated to receive, transmit and deliver all messages except those sent direct to the addressee, those handled by civil or military postal service, or those sent by local or special messenger. Its purpose is to speed transmission and receipt of authentic messages.

MESSENGER COMMUNICATION



This means of communication uses people to carry orders and messages. They are:

RUNNERS

Employed when other means are not fessible, when distances are short, or route is impassable for other messengers.

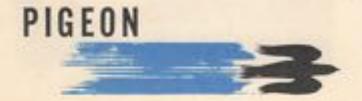
MOUNTED MESSENGERS (bicycle, motorcycle, horse) Employed when enemy situation and condition of route permit.

MOTOR MESSENGERS

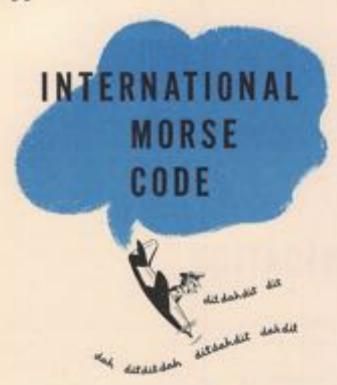
Normally employed between headquarters separated by not more than 4 hours' motor time, when mail service will not suffice.

AIRPLANE MESSENGER

Used when other means will not suffice. Important messages are often transmitted between widely separated units or between allied armies by this means. Airplane messengers use the drop message to relay information to ground units when other means are not available or secrecy is necessary. They employ the pick-up message to receive information from ground units when other means are not feasible.



This hardy and dependable bird is used in emergency when other means of communication fail.



The average layman associates Morse Code with dingy railway stations and sinking ships. He probably recognizes the now familiar 3 dots and a dash representing the "V" in "V for Victory." Doubtless he also knows that 3 dots, 3 dashes and 3 dots signify S.O.S. in any language. Aside from that, the dot and dash language to him is little more than gibberish which can be mastered only after years of study.

To acquire great speed at code, considerable practice is necessary. It is not hard to be moderately fast at it. However, we will attempt here only to give you a knowledge of code and sufficient speed to permit you to send and receive.

Code plays an important part in many operations, and may prevent disaster in emergencies not only in the air but on land or at sea.

It may seem unnecessary to you to learn International Morse Code since you can transmit and receive messages by voice. Code, however, is much superior to radio telephone for 3 reasons:

- When you use secret code, you can keep the transmissions unintelligible to anyone who does not have facilities for decoding.
- During periods of poor receiving conditions such as those caused by static, ignition noises, fading signals, etc., code is still readable after phone transmissions are out.
- The range is greater when using code and the cost of equipment is considerably less.

As a student, you must have confidence in your ability, and be determined to follow instructions. Thus you will avoid learning certain had operating habits which otherwise would retard your progress. Remember that code is not difficult, if you follow a few simple rules.

The first step is to memorize the signals. It is important that you learn the sound of each signal correctly at the beginning. Instead of visualizing the "dot" and "dash," try to think of them by the sound "dit" for "dot," and "dah" for "dash."

You will need to concentrate especially hard while learning the signals. With repetition, you will soon recognize the sound without thinking too much about it. Learn a few signals at a time, learn them thoroughly, and learn them by their sound.

Regular practice will train your mind and ear to recognize the sound in much the same way you new instantly associate meanings with the sound of spoken words. You can practice the signals which follow either by repeating the code to yourself or by whistling it.

It is important that you write down everything you hear and recognize. Listening without recording what you hear accomplishes little. If you miss something, leave it out and write what you recognize. There are many available short-wave broadcasts which will help give you practice.



PRINTING

A uniform method of putting on paper what you hear is essential. When you receive code print each letter, following the method illustrated below:

Α	В	С	D	E.	F
G	H	1	J	K	Ļ
M	N	0	P	Q	R
S	Ţ	U	٧	W	X
Y	Z	Ŧ	2	3	4
5	6	7	8	9	Ø

Note that the zero has a diagonal line running through it to distinguish it from the O.

We have divided the material which follows into lessons.

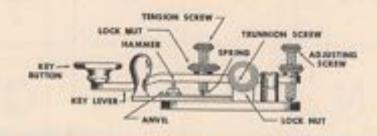
Learn each lesson thoroughly before proceeding to the next.

KEYING

You can receive only as well as the person sending can transmit. Hence, good sending is just as important as good receiving. It is important, therefore, to begin your sending practice in a correct manner. Bad habits acquired now will stick with you later.

You must adjust the key properly and space the

contacts correctly before you begin to transmit. The spring tension (coiled spring) on any key must be adapted to the individual. The spring adjusting screw controls this tension. If you have trouble in forming dits and dahs, change the spring tension until you are able to send both elements easily and correctly.





Your elbow (not forearm) rests on the table. There is space under your forearm and wrist. Your fingers are curved and flexible, not straight and stiff. The finger ends of your first and second fingers rest on

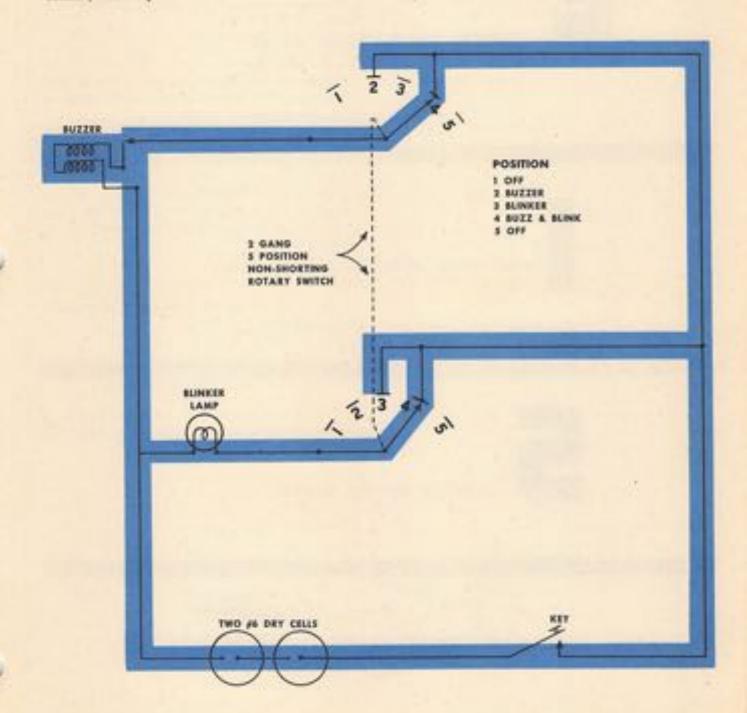
top of the button near the back edge. Your thumb is on the edge of the button, resting very lightly against it but not grasping it.

Although it is possible to practice the characters

without using a sending key, it is necessary that you have access to one sooner or later. You will have this opportunity in the class room. In case you want to practice sending at home, the simple diagram below will show you how to rig up your own buster.

Now with your fingers, wrist, and arm in the position described, press the key by a straight downward motion of the forearm. Your elbow stays in place. Your wrist acts as a hinge. Your fingers are flexed; do not let them be stiff. When the key has made contact, release pressure on the button and let the spring bring the key back to the up position. Do not allow your fingers to act independently. They merely take part in the coordinated actions of your forearm, wrist, and hand. Most of the work is done by the larger muscles of the forearm and upper arm. Continuous independent use of the fingers in sending will cause your hand to become tired and cramped.

When you're sure the key is adjusted properly, your forearm is moving straight up and down, your wrist is loose and operating like a hinge, and your fingers are flexible, begin your first lesson.



LESSON ONE

E

We'll consider the dit characters (letters) first. They are E, I, S, and H. Make the dit by closing and opening the key quickly. The sound produced is the letter E. Remember, the sound is the character. Memorize the sound, not dits and dahs.

Now make a string of E's, allowing the same space between them as follows:

dit dit dit dit dit dit dit

Repeat this procedure until you've firmly fixed the sound dit in your mind. Keep it short, and watch your spacing, making it uniform.

would indicate 2 E's.
practiced the E.

ditdit ditdit ditdit ditdit ditdit

The I is formed by 2 dits in quick succession. Key the letter so that it sounds like ditdit, not dit dit, which would indicate 2 E's. Repeat the following as you practiced the E.

Listen to the character as you sound it, and remember to space.

5

The character S is next in the dit series—3 dits in a row. It's ditditdit, not dit dit dit. Practice this like the others, remembering to space.

ditditdit ditditdit ditditdit





If you have difficulty forming this letter, or any of the previous characters, say it aloud to yourself. The H consists of 4 dits in quick succession, which you can say like this: ditditditdit. Be sure to key them evenly, smoothly. Now practice transmitting the H like this:

dindindirdir ditdirdirdirdir

EXERCISE ONE

Review all the dit characters you have covered before you undertake the word exercises. Be careful to concentrate on one letter at a time. Do not skip about too much before you are well acquainted with each. Practice these until you can recognize each one without having to besitate to figure it out. When confident that you know them, begin sending words made up of the letters you have learned. Keep the space between letters the same in each word. Key the individual letters just as you did before.

Now try the following exercises, striving for smoothness and uniform characters:

- h e ditditditdit dit
- h i s ditditditdit ditdit ditditdit
- s h e ditditdit ditditditdit dit
- s e e ditditdit dit dit

LESSON TWO

Spacing

In the first lesson, you learned the importance of forming characters accurately. You also saw the necessity for proper and uniform spacing. Proper spacing is absolutely necessary if you are to develop a good sending fist. As you begin to practice additional characters, maintain even spacing at all times until you know the alphabet. Uniform keying develops proper timing.

You must know how long to pause between the

characters of a word, and between words in a sentence. This is not difficult to learn, and proper spacing will become more clear as you progress. Here is a simple suggestion to help you learn proper spacing

The space between any two characters, such as E and I, equals 3 units. A dit is I unit, a dah 3 units. Therefore the space between E and I, or any characters, will equal the time required to send I dah or 3 dits.

The space between words is 5 to 7 units, or dits.

The second group of characters you will learn are the dah letters, T, M, and O. Begin with a string of T's, keeping the spacing equal between them: doh doh doh doh doh T T T T T T T

Repeat until you are familiar with the sound of the character T.

M

The M consists of 2 dahs in quick succession with no space between. Thus M is dahdah, not dah dah. The dahs are the same length; do not accent either one. This is true with all characters of any combination.

Now repeat the following exercise, as you did with the T:

dahdah dahdah dahdah M M M M



The letter O consists of 3 dahs—dahdahdah. Keep them uniform, with no space between However, don't forget to space between letters. Repeat the following exercise as before:

dahdahdah dahdahdah O O O

EXERCISE ONE

Now try the following exercise, watching construction of the letters, the spacing between them, and the spacing between words:

Tom dah dahdahdah dahdah

Motto dahdah dahdahdah dah dahdahdah

To dah dahdahdah

Mot dahdah dahdahdah dah

Tot dah dahdahdah dah

Otto dahdahdah dah dahdahdah

Using all the letters which you have now learned, make other words of them. Send them over and over for practice. If you are practicing with someone,

divide the time with him for sending and receiving. You should both insist on proper construction and spacing, observing all previous suggestions:

EXERCISE TWO

is it to he oh so his tie hit
see she tee sis tom tot tee sit
time set met miss home some hose
mess those moose sheet meets shims messes

EXERCISE THREE

(Don't try to learn the period now, it will come later.)

Try these:

She misses the home.

He met Miss Smith.

The tot shot moose.

A

The A is made up of a dit and a dah, with no space between the 2 elements. Thus A is ditdah. Make it smoothly. Keep the length of both the dit and dah correct, not too long for the dit or too short for the dah. Follow the procedure you've learned for speed and spacing.

ditdah ditdah ditdah ditdah

N

The letter N is dahdit. Practice a few as you did with the A.

dahdit dahdit dahdit dahdit N N N N N N

D

The D is dahditdit, without spacing. Key it smoothly, so that there is no pause between the elements.

dahditdit dahditdit dahditdit
D D D D

U

The U is ditditdah.

ditditdah ditditdah ditditdah U U U U

EXERCISE ONE

Don't undertake this exercise until you have learned the previous lesson thoroughly. The first word is "not." Transmit it like this: dahdit dahdahdah dah

Practice the following words, observing uniform spacing:

not	man	dim	to	and	due	the	sat
dot	men	mat	had	nut	hot	hut	see
ate	mist	shoe	done	main	dies	moon	dude
unit	shut	moan	dust	man	note	steam	taste
moose	union	house	shoes	mouse	sound	soda	deeds

EXERCISE TWO

If you have learned the above well, begin practicing sentences. Here's an example:

The man has shoes on.

dah ditditditdit dit dahdah ditdah dahdit

ditditditdit ditdah ditditdit

ditditdit ditditdit dahdahdah dit ditditdit

dahdahdah dahdit

Try these:
It is a dude home.
The man died in the hot steam.
The mouse did not mean in the house.
The dust and mist dim the moon as a mat.

LESSON THREE

If you are visualizing dits and dahs instead of learning to recognize characters by sound, something is wrong, and you must correct it before you proceed. Use every spare moment to sound different letters, as you see them in newspapers, on sign boards, in letters, wherever you may be. Say them aloud if possible, otherwise in a whisper. Hundreds have used this practice to increase their sound proficiency, and it is effective.

Regular practice is important provided you develop

correct habits. It is more important to practice regularly than for long periods. You will accomplish much more in 15 minutes of concentrated practice each evening than in 2 hours' practice once a week.

Accuracy is more important than speed. Don't become discouraged if you fail to gain speed. This will be attained later through practice and familiarization. Eventually you will be able to recognize words and phrases by sound, much as a child recognizes the words "mother" and "father."



The character W is formed with a dit and 2 dahs in quick succession. Practice as before:

ditdahdah ditdahdah W W W

G

The G is dahdahdit, exactly the reverse of W.

dahdahdit dahdahdit G G G

V

The letter V is ditditditdah-3 dits and 1 dah. Say it aloud before you key it, smoothly and without stuttering. Now imitate the vocal sound on the key, ditditditdah. Practice as before.

ditditditdah ditditdah ditditdah

B

The B is dahditditdit. Keep your specing uniform between characters.

dahditditdit dahditditdit dahditditdit B B B

EXERCISE ONE

Practice the following words, observing spacing. Don't attempt to gain speed yet, but seek accuracy.

beg	wag	visit	basin	gown	bead	wagon
edge	bug	vague	gun	women	waste	bath
vain	west	baton	dug	vat	good	
vacuum	base	weeds	baste	wean	van	

EXERCISE TWO

When you have mastered these words, practice the following sentences:

A wagon van moves on.

A woman has the gun now.

It is a bad thing to waste good shoes.

The gown has beads on it and is in vogue.

A visit to the dentist in time saves teeth.

He wants to bathe now so get out with haste.

CHARACTERS OF SIMILAR SOUND

You may experience difficulty at first in distinguishing between certain characters similar to others. These may be the so-called opposites, such as W and G, B and V, and A and N, or they may be letters like S and H.

If you find that you have this trouble, especially in receiving practice, make up a number of words in which they both appear. Have someone send them to you over and over again until you can identify each character by its sound. Constant practice will overcome this difficulty.

Continue this exercise until you can both send and receive such characters at slow speed, and without hesitation.

Slow speed is not more than 5 words per minute. You are sending at that rate if, in the following exercise, you send the group from "an" through "tm" in 1 minute.

on no du ud gw wg by vb mt tm sh he is ei

LESSON FOUR

If you have carefully followed instructions, developed good habits and are thoroughly familiar with the sounds of all characters covered so far, you have

taken a big step in learning the code properly. The remaining characters should be less difficult. Practice now as you have in previous lessons.

R

ditdahdit ditdahdit ditdahdit

R

R

R

K

Repeat K several times vocally before you begin keying it. This will help you to keep it smooth.

dahditdah dahditdah

Now practice these two characters together.

ditdahdit dahditdah ditdahdit dahditdah ditdahdit

R

K

R

K

R

F

The F is ditditdahdit, Sound it vocally before you key it. Keep it smooth, Then key it,

ditditdahdit ditditdahdit

F F F

WHAT PLANES ARE THESE?





Check your snower on page 5-36



The L is ditdahditdit. Practice vocally first as you did with F, then key it.

ditdahditdit ditdahditdit ditdahditdit
L L L L

Now practice F and L together:

ditditdahdit ditdahditdit ditdahditdit

F L F L

EXERCISE ONE

Practice the following words:

if of are vale other took leaf battle left felt feel else girl kill roll fun four know watt roof rook from great laughter three length word war learn long error effort list more letter make before all forest seek fake last value duke urge run take

EXERCISE TWO

Practice these sentences after you have learned the words thoroughly:

All of us make errors.

His wife is an invalid.

The car killed the robbit.

Be sure to sound the letters.

It takes time to run down there.

LESSON FIVE

EXERCISE ONE

Concentrate on the following letter groups and words, sounding and keying each group several times before passing to the next:

sh no du wg vb fl rk me ei gw if bv ud sh bd aw uv am si if go ve kr na tm om fu rl in uf ew am uv kr if et ud an gw fl rk di awv abd tmo eis nko auf abd reif urw adu shi tuv eau tnd ubd ina gwo awk Ifu drb dub ish flr gwa adn fry iky flag wagon rook verb unveil nation left bavine bash governor rako their been frog dubbed milker duke elf bladder left sight kind series house alarm bank strike hasten wags leef then stove killer daub most

J

The J is ditdahdahdah. Practice it as before; first vocally, then with the key.

ditdahdahdah ditdahdahdah

P

The P is ditdahdahdit. Practice it vocally, first. Avoid any pause that might make it sound like ditdah dahdit or ditdahdah dit. Now key it:

ditdahdahdit ditdahdahdit
P P

WHAT PLANES ARE THESE?





Check your strawer on page 5-20



The X is dahditditdah. Make it smoothly so that the sound produced is not identified as na or tu, or a similar combination. If you construct a letter incorrectly to begin with and do not correct the mistake, you have acquired a bad habit, difficult to break.

dahditditdah dahditditdah

Z

The Z is dahdahditdit. Use the same care in keying the Z as you did with the others. Unless you do, you will be making ge, td, or mi.

dahdahditdit dahdahditdit Z Z

EXERCISE TWO

Practice the following words, a few at a time until you have mastered them:
job pix zero pen jezz rex opert extra flop sex jell post jehn
pill jessie toxes top jein expert lemp power jemes axe zipper
nop zip wi xx pg lp wp gz dx jp zm rp pl jw mi wi
we to ee td pl no go xp og dt om oj xd xx pj zd xu zg
ee on td px

EXERCISE THREE

Jessie James was an expert shot.

The zipper snap fails to work,

John has a job in a jazz band.

The power of the press was upheld.

Safety is the responsibility of all.

LESSON SIX

You should now realize the importance of proper construction and spacing of letters and words. If you have developed any bad habits which tend to confuse certain letters, attempt to correct them before you proceed. The records from which you are learning to receive code are correct; use them as a guide.

EXERCISE ONE

In this exercise pay particular attention to proper formation of the letters and spacing between letters and words. Take turns sending and receiving the following sentences:

It is important that the sound of all signals be learned right. Memorize the sound, not the dits and dahs, keeping the sound of the letters in mind at all times.

Extra moments spent in drilling with letters that give trouble are worthwhile.

Making up words that have letters of similar sound in them is one of the best forms of drill.

C

The C is dahditdahdit. Practice sending it, vocally and by key.

dahditdahdit dahditdahdit

Y

The Y is dahditdahdah. Practice as before.

dahditdahdah dahditdahdah



The Q is dahdahditdah. Do not make it ma or gt, or

dahdahditdah dahdahditdah

EXERCISE TWO

quick check yellow young clique occur question such come quell space quart practice quack queen yacht celery quarry factory color sequence

The check was for a yellow yacht of questionable ownership.

There was a quarry located near the occupied zone.

Young Queen Mary quickly qualified as an authority.

Twenty mayors determined the connections necessary.

Conning towers are the main exit on submarines.

EXERCISE THREE

ma kt gt nm tw nm tr ke eq yq ey
maq kty qtg tky nmy twy nnc trc kec cnn ytw qma
tem met tta ten ste tat ntt tat tae eyu gey gym
ona maa cnc qmt ykt nny ckt qcy two gtq ywa qaa
fly udq she gyw yna uvq kqr dbe tfq vby sic fle
shyq lfyc krąc dqby vyqb wągc yąck isgy hack fqly cudy cgwc

EXERCISE FOUR

yet flay satisfy quay quickly censor difficult proceed ticket annoying condole shipwreck yesterday they tenstrike made twofold nensense nite flyer meter cinema traffic twice kept tempt sick coming running playing truce maiden train manner mayor employer

LESSON SEVEN

Faithful, regular practice with the preceding exercises should have done much to help you become proficient at making the sounds of the entire alpha-

bet in code. From this point, make every effort to perfect your sending. Remember: Practice daily, even if you can devote only 15 minutes to it.

EXERCISE ONE

Take turns sending and receiving the following words, smoothly and accurately:

say gof has but had be the very exe zero too man may out this were often gove said send made them bud wag beg should after part soon time right she tom must some that war dug bets beed else run take begin ettend gem past deal tired value zippor sizzle truce play cannot limit pane laid twenty club today axis how moke effort forest 10119 took dobbed wagen rake Jazz james pill sex jopen extre yellow come code with take wigh game get firm butter name mass stay dumb wage tired weep extra bay due self easy

NUMERALS

Before beginning the practice of numerals, spend some time sounding and keying a series of dits and dahs, keeping them uniform and properly spaced. This will help you to construct the combinations, and you will not be making a number of letters from a group of sound units intended for a numeral.

First, make dits-at least 100 of them-with just a little space. Watch your timing so that they sound as if they were being made by a machine. Then gradually shorten the space, or pause, between dits until practically no space exists. Make them in groups of 25, slowly at first, speeding up as you progress.

Repeat the same procedure with dahs.

Taking 2 numerals at a time, use the same tactics as described previously, watching your spacing particularly. Learn the sound; forget the appearance.

NUMBER 1 IS ditdahdahdahdah. NUMBER 9 IS dahdahdahdahdit.

EXERCISE TWO

As soon as you've learned to distinguish these, practice the following exercise:

NUMBER 2 is ditditdahdahdah. NUMBER 8 is dahdahdahditdit.

EXERCISE THREE

As soon as you've learned these, practice as in the previous lesson:

NUMBER 3 IS ditditditdehdeh.

NUMBER 7 is dahdahditditdit.

NUMBER 6 IS dahditditditdit.

NUMBER 4 IS dirdirdirdirdoh.

EXERCISE

EXERCISE FOUR

4 4 4 4 4 4 4 4 4 46 46 46 46 46 46 46 46 46 • 464 464 464 464 464 464 464

NUMBER 5 IS diediediediedie.

ZERO is dahdahdahdahdah.

EXERCISE FIVE

B6 II 5H V4 3V Z7 Z8 6TH 7M5 5M3 7M5 018 HT4 HE5 198 796 143 210 865 431 237 374 982 101 3427 8769 1976 4315 2135 4632 9061 4036 7849 3129 3142 3124 12345 68594 01342 52964 89413 29473 89541 10311 19735 59302 12438 04173

LESSON EIGHT

It is a mistake to assume that it is easier to send good code than to receive. Anyone can manipulate the key after a fashion, but it takes faithful practice to learn to send good, readable code. You must make characters correctly and spaces must be 'uniform if the receiver is to get them correctly.

You have practiced transmitting by key, and receiving either directly from the key or from recordings.

Even without these, however, it is possible to attain a certain degree of proficiency. You can repeat characters verbally, and where you have a practicing partner you can receive while he transmits in this manner.

Although such practice is valuable to you as a student, sconer or later it is necessary for you to obtain actual practice on a key.

REVIEW

Turn back to the first code lesson given you in this manual. Using the key, start with the first lesson and practice sending. Follow the instructions given for every character, and continue this practice through all lessons to the present one. Be sure to follow instructions in the illustration in Lesson One on adjustment and proper position of the hand on the key. EXERCISE: When you have mastered each character so that you can send it evenly and with correct timing, concentrate on the following exercise:

	1	5 1	1 5	T	M	0	92	A	- 01	W.	3
A	w	1	10.	N.	D			86		100	7
H	K	6	Y	M		0		u		2	
A		K.		A	w			D	×		
H	4			71	2	3	4	. 4	7		

"The numeral zero is printed Φ to distinguish it from the letter O; the numeral 1 is printed 1 to distinguish it from the printed i, and Z is E to distinguish it from the numeral 2.

PUNCTUATION MARKS

Now, you must add a few punctuation marks to your code vocabulary. The following are in common use and you should learn them well. Sound them over as you did the characters:

.) ditdahditdahditdah
.) dahdahdiidiidahdah
?) ditditdahdahditdit
/) dahditditdahdit
ditdahditditdah

Note: The fraction bar is transmitted between the numerator and denominator of a fraction. Example: 2%.

The separation sign is transmitted between a whole number and a fraction and indicates that a fraction is about to be sent. Example: The mixed number 24% is transmitted:

ditditdahdahdah ditditditditdah ditdahdahdahdah ditdahdahdahdah ditdahditdahdit ditditdahdahdah ditdahditdahditdah

Exercise: Practice the following sentences, transmitting punctuation marks:

Who is it?

Maps, documents, photographs, and zebras are available.

We have 36½ dozen message blanks on hand. He commands an army of 2,500,000 men.

LESSON NINE

Pilots forced down at sea today carry flashlights and metal mirrors as part of their necessary equipment. The reason precious space is taken up with such items is that pilots consider signal equipment almost as important as water in their battle to live.

Without means of communication, their chance of survival is slim.

The mirrors are used when the sun is shining to signal possible rescue aircraft and boats. The flashlights can be used at night to transmit the always familiar S.O.S.

Signal units in the battle of Italy penetrated deep into enemy territory early in the campaign, discovered an ambush, and signalled Allied artillery. As a result, the enemy was beaten back and an otherwise tragic defeat was probably avoided.

In many such instances, blinker signals are the only possible or safe means of communication.

You have learned the code. The illustration in Lesson One shows you how the blinker operates. If possible, rig up a blinker, and practice sending. You will operate the key in the same way, but you naturally must do it at a considerably slower rate.



You probably have taken for granted the ease and clarity with which your favorite radio announcer talks. Yet his casual tone and clear enunciation are not entirely luck. They are the result of considerable study, not only by him, but by radio and sound engineers. Thus, when he stands in front of the microphone, the odds are in his favor.

The pilot or radio operator of an airplane is not so fortunate. He speaks from the noisy cockpit of a plane, not a soundproof studio. The person listening to him probably experiences the same difficulty. If static, either man-made or atmospheric, is present, the problem is further complicated. Try listening to your radio while Dad is using his electric rater and you'll understand how difficult it is to hear.

Because transmission and reception of verbal messages are usually performed under such conditions, a uniform radiotelephone procedure is essential.

You have already learned the meaning of military discipline. Radio discipline is another type of military discipline, and is just as important as close order drill or saluting.

You must carry on radiotelephone conversation, or transmission, in a business-like manner. That means you will refrain from making personal remarks, or giving your listener the details on the blonde you had a date with last night. Remember, while you indulge in aimless chatter, you may be interfering with the transmission of an important message which involves the safety of others.

Radio is the principal means of communication between aircraft in flight, among passengers by interphone within an airplane, and for air-ground communication. Radio sets fall into 2 general classes—those installed in aircraft, and those installed in ground stations.

Transmitters are capable of operating either as radiotelegraph or radiotelephone.

Radiotelegraph has the advantage of:

Greater distance.

Ability to compensate for interference.

Greater secrecy.

The range of radio communication is dependent upon the power of the transmitter, the frequency used, the time of day or night, and upon the noise level at the receiving station.

Radio communication is not secret. Therefore cryptograms are used extensively in the transmission of messages by radiotelegraph and radiotelephone.

It is easy to locate radio transmitters by use of direction-finding equipment. It is important, therefore, to make transmissions as brief as possible, and as infrequent as possible.

Other types of radio communication include:

Instrument landing systems, radio ranges, radio broadcast stations, radio compass and direction finders, radio marker beacons and rescue boat installations.

How to Talk

Don't use a normal tone when speaking into the microphone. Hold the mike directly in front of and an close to your mouth as you can, and raise your voice as much as possible without straining or distorting it. Speak distinctly, and don't allow your voice to trail off at the ends of words and sentences. Remember you are competing with outside noises.

PHONETIC ALPHABET

Newspaper reporters apply the principle of the phonetic alphabet frequently when telephoning stories to their city desks, particularly when giving proper names. You may have resorted to the same tactics when talking over the telephone. Suppose you are telling someone on the other end of the line how to spell your name, Stevens. You might say S as in sap. T as in take, E as in Eden, V as in Volga, E as

in Eden, N as in name, S as in sap.

The Army Air Forces use this same method in radiotelephone procedure, except that now you have a standard phonetic alphabet which is understood universally, rather than one of your own invention.

Learn the following Army Air Forces alphabet. When it is necessary for you to identify any letter of the alphabet, this alphabet is to be used:

Letter	Spoken As	Letter	Spoken As
A	Able	M	Mike
	Boker	N	Non
c	Charlie	0	Obse
D	Dog	P	Peter
	Easy	Q	Queen
F	Fox	R	Roger
G H	George	5	Sugar
н	How	T	Tore
1	Item	U	Uncle
1	Jig	V	Victor
K	King	w	William
L	Love	X	X-ray
		Y	Yoke
		Z	Zebre

Code words such as Luxow will be spoken as "Love Uncle X-ray Oboe William."

Difficult words such as "cutenary" will be spoken and spelled. Example:

"Catenary—I spell—Charlie Able Tare Easy Nan Able Roger Yoke—Catenary."

NUMERALS

When you transmit figures by radiotelephone, pronounce them as follows:

Numeral	Spoken As	Numeral	Spoken As
0	Ze-ro	5	Fi-yiv
1	Wun	6	Six
2	Too	7	Sev-en
3	Thub-ree*		Ate
4	Fo-wer	9	Ni-yen

Transmit numbers as numerals or digits, except in the case of an even hundred or thousand when the word "hundred" or "thousand" is used:

Number	Spoken As
44	Fo-wer fo-wer
80	Ate ze-ro
136	Wun thuh-ree six
500	Fi-yiv hun-dred
1478	Wun fo-wer sev-en ate
7000	Sev-en thow-gand
16000	Wun six thow-rand

Twenty-Four Hour Clock

Always state Army time in 4 figures, using the 24hour clock. This is done to eliminate the possibility of error and to make it unnecessary to use a.m. and p.m. The first 2 numerals state the hour, the last 2, the minutes.



Example:

Time	
0000	(midnight)
0920	(9:20 AM)
1200	(noon)
1647	(4:47 PM)

Spoken As

Ze-ro ze-ro ze-ro ze-ro Ze-ro ni-yen too ze-ro Wun too ze-ro ze-ro Wun six fo-wer sev-en

Call Signs

Call signs identify either the transmitter or receiving station.

Airplane call signs consist of numbers, letters, words, or combinations of them. Example: "Army six too ze-ro," "Waco wun ate wun fo-wer thuh-ree," etc.

Control tower call signs contain the name of the airport followed by the word "tower." Example: "Sacramento Tower," "Scott Tower."

Radio range call signs consist of the name of the Army field, civil airport, or other place at which they are located, followed by the word "radio." Examples: "Chanute Radio," "Mobile Radio."

Parts of Message

The radiotelephone message has 3 parts—the call, the text, and the ending. A call will follow this sequence:

Call sign of receiving station, Connecting phrase.

Call sign of the transmitting station.

EXAMPLE

Cell: Army six too thuh-ree ze-ro

From

Chanute Radio.

Reply: Chanute Radio

From

Army six too thuh-ree ze-ro.

The text of the message may consist of plain language, code words or groups, or figures.

Every transmission will end with the words "over" or "out." This procedure is explained more fully under the sub-heading Radio Language.

WHAT PLANES ARE THESE?





Check peer senser on page 3-30

SAMPLE MESSAGE

Call "Shamrock from Domino,"

Text "Where are planes?"

Ending "Over."

Call "Domino from Shamrock."

Text "Planes are at base."

Ending "Out."

EXAMPLE TWO

Nashville Tower transmits:

"Stinson wun too thuh-ree fo-wer from Nashville Tower.

"What is your position?-over."

Stinson 1234 transmits:

"Nashville Tower from Stinson wun too thuh-ree fo-wer.

"Ni-yen miles south at ate hun-dred-over."

Nashville Tower transmits:

"Stinson wun too thub-ree fo-wer from Nashville Tower-cleared to land-traffic north-runway thubree six-out."

Repetitions

If you miss words or are doubtful that you heard correctly, request the transmitting operator to "say again." He will repeat the section you missed, preceding the repeat by saying "I say again." In requesting repeats, always specify the portion you need, indicating with the remark "all before," "all after," or "word after." The transmitting station will always repeat the words you used to identify the portions requested.

EXAMPLE THREE

WXBF transmits:

"KXYZ from WXBF-Roseville squadron has sighted wreckage near top of mountain wun fi-yiv miles northwest of Placerville-over."

KXYZ transmits:

"WXBF from KXYZ-say again all after mountainover."

WXBF transmits:

"From WXBF-I say again-mountain wun fi-yiv miles northwest of Placerville-over."

KXYZ transmits:

"From KXYZ-roger-out."

RADIO LANGUAGE

It is impracticable to decide on precise wording for all procedure phrases which you might need to transmit messages. You'll use a few which have been adopted, when applicable. Be sure to use them only to express the meanings indicated here. Other words which you might substitute may have an entirely different operational meaning. If you make a mistake, correct it before continuing. State the word "correction," then proceed with the correct version.

Word or Phrase	Meaning
Roger	Received your message.
Acknowledge	Let me know that you have received and understood my message.
Wilco	Will comply. (Use Wiles to indicate that you will carry out orders or instructions.)
Over	Transmitting operator ex- pects reply.
Out	End of communication.
Wait	I must pause for a few sec- onds.
Wait out	I must pause longer than a few seconds.
How do you hear me?	(As words indicate.)
Speak slower	(As words indicate.)
Say again	Repeat
I say again	I will repeat.
Message for you	I wish to transmit a message to you.
Send your message	I am ready for you to trans- mit.
Break	Separate this text from rest of message.

STATIONS IN GROUPS

Several stations often work in a group, or on the same frequency. When transmitting in groups of this type, repeat the call sign of the receiving station at the end of the message. A station in the group which does not hear the first call and tunes in late will then know for whom the message is intended. Stations working in groups should answer in the alphabetical and numerical order of their call signs. The alphabetical stations should answer first when both operate on the same net.

Signal Strength

You will assume that the person receiving your transmission can hear you satisfactorily unless he notifies you otherwise. When making original contact, you may ask, "How do you hear me?" His response should be, according to reception, "Weak but readable," "Strong but distorted," etc.

Two-Station Net

Assume that stations AWM and JFC are engaged in 2-way communication.

JFC transmits: (Establishing communication)

"Able William Mike from Jig Fox Charlie-How do you hear me?-over."

AWM transmits:

"Jig Fox Charlie from Able William Mike-Okayover."

JFC transmits:

"Able William Mike-message for you-over."

AWM transmits:

"Send your message-over."

JFC transmits:

"Proceed to Shangri-la-I spell-sugar how able Nan George Roger item love able-too thuh-ree fi-yiv ni-yen hours-time wun six ze-ro ze-ro-correctionwun fi-yiv ze-ro ze-ro-read back all after timeover."

AWM transmits:

"Time wun fi-yiv ze-ro ze-ro-over."

JFC transmits;

"That is correct-out."

Four-Station Net

Assume that the following stations on a 4-way net are in communication:

AWM net control station (controlling station).

AB1 subordinate station.

AB2 subordinate station.

AB3 subordinate station.

XYZ net call (collective call for all 4 stations).

Example: AWM has a message for all stations on the net.

AWM transmits:

"X-ray Yoke Zebra from Able William Mike-message for you-over."

ABI transmits:

"From Able Baker Wun-send your message-over."

AB2 transmits:

"From Able Baker Too-send your message-over."
AB3 transmits:

"From Able Baker Thuh-ree-send your messageover."

AWM transmits:

"X-ray Yoke Zebra-proceed to Shangri-la-I spellsugar how able Nan George Roger item love abletoo thuh-ree fi-yiv ni-yen hours-time wun sev-en ze-ro-over."

ABI transmits:

"From wun-roger-out."

AB2 transmits:

"Too-say again-all after word proceed-over."

AWM transmits:

"Too and thuh-ree—I say again—words twice—proceed to Shangri-la—proceed to Shangri-la—I spell sugar how able Nan George Roger item love able—I spell—sugar how able Nan George Roger item love able—too thuh-ree fi-yiv ni-yen hours—too thuh-ree fi-yiv ni-yen hours—time wun sev-en ze-ro ze-rotime wun sev-en ze-ro ze-ro-over."

AB2 transmits:

"Too-reger-out."

AB3 transmits:

"Thuh-ree-roger-out."

Later AB2 wishes to have the receipt of this message verified.

AB2 transmits:

"Able William Mike from too-verify message-time wun sev-en ze-ro ze-ro-over."

AWM repeats message, and AB2, acknowledging, transmits:

"Too-roger-out."

AWM wishes to correct message, transmits:

"X-ray Yoke Zebra-message time wun sev-en ze-ro ze-ro-correction word after Shangri-la-too too fi-yiv ni-yen-I say again-too too fi-yiv ni-yen-acknowledge-over."

Each subordinate station sends in turn:

"From (ABI, AB2, AB3)-roger-out."

CONTROL TOWER

Every pilot either departing from or arriving at a field must contact the control tower before takeoff or landing.

The tower operator uses either radiotelephone or light signals to transmit takeoff and landing instructions. He usually notifies the pilot of: (1) wind direction and velocity. (2) runway and field conditions, (3) special instructions concerning local conditions,

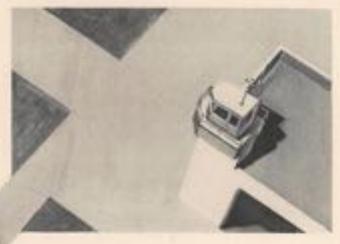
(4) taxi clearance, (5) takeoff clearance, (6) altitude of field, and (7) correct time (if time is requested).

EXAMPLE

Suppose you are in the cockpit of a P-38 at the National Airport in Washington, preparing to take off for New York. Your conversation with the tower would run something like this:

You: "Washington Tower from Army fo-wer fi-yiv ni-yen ze-ru-over."





Tower: "Army fo-wer fi-yiv ni-yen ze-ro-from Washington Tower-over."

You: "Taxi clearance-over."

Tower: "Wind east twelve E wun too-field is soft use east-west runway—heavy construction in progress southeast of field—taxi to west end of east-west runway—over."

You: "Wileo-out."

(Upon departure, you will remain tuned to tower frequency for at least 5 minutes unless cleared to another frequency by the tower.)

Assume you are now 10 miles south of LaGuardia Field, New York, and wish to land there. Your message would run like this:

You: "LaGuardia Tower from Army fo-wer fs-yiv ni-yen ze-ro-over."

Tower: "Army fo-wer fi-yiv ni-yen ze-ro from La-Guardia Tower-over."

You: "Ten miles south of field at too thou-rand feetcontact-landing at LaGuardia-over."

Tower: "Roger-out."

You: (Arriving at field) "LaGuardia Tower from Army fo-wer fi-yiv ni-yen ze-ro-landing instructions over."

Tower: "Army fo-wer fi-yiv ni-yen ze-re from La-Guardia Tower-wind south-west fifteen SW wun fi-yiv-Tayltercraft sev-en ze-re six fi-yiv now approaching field to land-field is soft-use the northeast-southwest runway-you are second to landover."

You: "Roger-out."

Tower: "Army fo-wer fi-yiv ni-yen ze-ro from La-Guardia Tower-you are cleared to land-over."

You: "Wilco-out."



WHAT MAKES AN AIRPLANE FLY

As you have watched an airplane take off from the ground, ships, turn, measurer, glide, and lone again on the ground, you may have asked yourself: "What makes it fly?" "How does the pilat make it do what he wants it to?" "How rould the men who designed the airplane forestell that it would fly, or how it would perform in the air?" * These are all perfectly reasonable questions, and you can find the apawers to all of them in the study of the theory of flight. You will discover there is nothing mysterious in the fact that as airplane designer can work out on paper the detailed plan of an airplane, and tell you before it is ever built how fast it will fly, at what airspeed it will take off the ground, how much weight it can carry—in fact, almost anything you want to ask him about it. * He knows what the airplane he has designed will do because there are laws and principles of flight and design. The discussion that follows in this section is designed to explain some of the fundamentals upon which the science of aviation is built.

IN THIS SECTION ...

Theory of Flight

Why Lift is So-Called—How Lift is Produced: Design of the Wing, Effect of Moving It Through Air, Importance of Air's Weight and Volume—Why Speed is Necessary to Lift—Relation of Angle of Attack to Lift—How Much Lift on Airplane Needs—What Drag is—Dead Drag and Useful Drag— The 4 Forces of Flight

Stability

Why Planes Must be Stable and Controllable'—What Inherent Stability Is—Vertical and Horizontal Stabilizers and What They Do—The Axis of Yaw—The Axis of Pitch—The Axis of Roll—Function of Control Surfaces—How Ailerons Work—What the Rudder Does—How the Elevators Work—Why Pressure Must Be Coordinated—What Trim Tobs Are and How They Work

Structure of Aircraft

Under the Skin of a Fuselage: Two Kinds of Construction—The 3 Parts of a Wing—Two Types of Wing Construction: The Sper Wing, The Broced Stressed-Skin Wing—Shocks Which Landing Gear Most Stand—How Tricycle Landing Gear Works—The Conventional 3-Point Landing Gear

Instruments

Purpose, Principle, and Description of Magnetic Compass—Two Kinds of Compass Errors—Difference Between Variation and Deviation—What Causes Flight Errors in Compass—Purpose, Principle, and Description of Altimeter—Barometric and Temperature Errors in Altimeter—Preflight Check—Purpose, Principle, and Errors of Airspeed Indicator—Preflight Check—Purpose, Principle, and Preflight Check of Rate-of-Climb Indicator

Power

Man's Struggle to Get Power Enough to Fly... The 4 Strakes of a 4-Cycle Engine... What Happens in the Carburetor... Ignition System... Preflight Magneto Check... Liquid-Coaled Engine... Air-Coaled Engine... In-Line Engine... V-Type Engine... Opposed or Flat-Type Engine... Radial Engine... Purpose and Description of a Propeller... How Propeller Fitch Affects Airplane in Flight... What a Constant-Speed Propeller Is... Engine Instruments: Tachometer, Oil Temperature Gauge... Minimum Engine Preflight Check



THEORY OF FLIGHT

LIFT

You know that a balloon goes up in the air because it is filled with a gas that is lighter than air. The force that lifts the balloon is buoyancy, and we call an airship that is lifted by such means a lighterthan-air ship.

We are not concerned in this study with lighterthan-air craft, but we call it to your attention to begin the discussion of lift.

Anything that goes up into the atmosphere off the earth must have some force to lift it off the ground. Even the lightest airplane is a relatively heavy thing, and large bombers weigh many tons. Before an airplane can fly it must be lifted off the ground, and once it is in the air it must be kept there by some force. That force is called, logically enough, lift.

How Is Lift Produced?

There are three steps in the explanation of how lift is produced:

- I. A wing is so designed that when
- 2. A force moves it at the right speed and in the right direction through the air,
 - 3. The air so acts upon it that we get lift.

Let us take each of these steps and explain them.

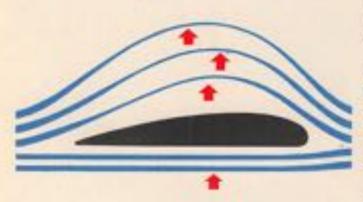
FIRST STEP: The Design of the Wing



If you have ever built a flying model airplane, you remember the shape of the wing. It is rounded at the front, which is called the leading edge of the wing. It is sharp at the back, or trailing edge of the wing. The upper surface is curved; the bottom is almost a straight line. It is thick and stubby near

the leading edge and thin and tapered near the trailing edge. You will soon learn why it's shaped that way. Take that rib and study it, for it represents the eross section of almost any airplane wing. Wing sections of various airplanes differ slightly in detail, but the principle is the same in all airplane wings.

SECOND STEP: The Effect of Moving an Airplane Wing Through the Air



If we move the wing through the air at a relatively high speed with the blunt end (leading edge) forward the following things happen:

The blunt and thick leading edge pushes air out of the way. Part of the air so displaced flows over the wing; part of it flows under the wing rapidly (the speed is important). The layers of air, after going over and under the wing, join again behind the trailing edge. But the important thing is that the air that flowed over the wing had to go farther than the air that went under the wing.

In going farther it stretched out, so to speak, and became thinner. Loosely speaking, it formed a partial vacuum at the top of the wing and exerted force while the air at the bottom of the wing compressed slightly and exerted a certain force there. The sum of these two forces represents lift because—

THIRD STEP: The air has weight and volume



When air moves, its weight and the speed (velocity) with which it moves exert energy and do work. The same is true of anything which moves through or against air.

The design of the wing and the speed with which it is moved through the air give us lift.

WHY IS SPEED NECESSARY TO LIFT?



We mentioned in Step Two that we must move a wing "at a relatively high speed through the air" to make it work. What happens when we move it slowly?

Suppose you take a board and move it edgeways through the water, holding it at a slight angle to the direction in which you are pushing it. If you push it rapidly you will see that the water rushes out of the way of the leading edge, leaving a hole (or vacuum) at the top of the board. This water doesn't join the water from the bottom of the board until the board is well past.

Push it slowly, however, and the water swirls and burbles in on top of the board. That is what happens, approximately, to the air that your wing displaces. The low pressure area above the wing is speiled if the wing moves too slowly; the air swirls and burbles into the partial vacuum.

The heavier an airplane is in relation to its total wing surface, the higher speed it requires to develop lift enough to get off the ground.



LIFT AND ANGLE OF ATTACK

There is another thing that affects the amount of lift you get from a wing and that is the angle at which you direct it into the air. In the example above we said we would move it straight ahead. We get some lift that way, but we can get more lift if we tip the front edge up and attack the air at a higher angle of attack.

The wing now displaces more nir (that is, it makes the air over the wing travel farther) and, up to a point, gives us more lift. When we get past a certain point, however, we are pushing so much air out of the way that our airplane slows down. The air swirls and burbles into the low pressure area on top of the wing. We have increased the drag too much. (We'll explain that later.) Accordingly, we lose lift and approach a stall.



HOW MUCH LIFT DOES AN AIRPLANE NEED?

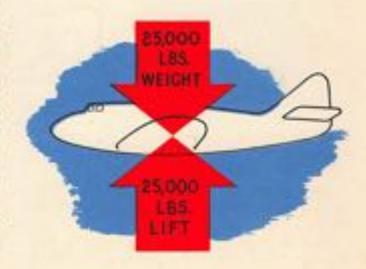
The amount of lift, then, is determined by (1) the design of the wing, (2) the speed of the airplane, and (3) the angle of attack. Now is it necessary or desirable to get as much lift as we cam? Or is there a point at which we don't need any more?

Think it over a minute. Just how much lift does an airplane need?

The answer to that is, how much does your airplane weigh? You need enough lift to overcome the force of gravity.

To climb you need more lift than the force gravity is exerting. As long as you have more lift than weight, your airplane will continue to climb.

However, when you wish to fly straight and level, at a constant altitude, lift and gravity must exactly balance each other. If lift is greater, you will climb; if gravity is greater, you will descend.





So you can see the designer of an airplane must figure his lift in relation to the gross weight of his finished airplane and the total load it is to carry.

We told you that to produce lift you have to move a wing through the air at relatively high speed. In flying model airplanes that you may have built, you produced the movement through the air by means of a propeller and strands of rubber. By winding the rubber strands you made the propeller rotate with enough speed to pull the model forward. When it got up enough speed it took off the ground and flew.

The force pulling the airplane through the air we call thrust.

How Much Thrust Does on Airplane Need?

That is an important question. You must know the answer to it before you can figure how powerful a powerplant you need. That is, how much ho, sepower your engine has to develop to do the work that you want it to do. Let's see just what that work amounts through the air, some of your thrust turns to lift.)

You know it takes more power to start an automobile and speed it up than it does to keep it going once you have started it. That's why you have low and intermediate gears in a car. It takes more power to climb a hill in a car than it does to speed over a level highway. So in an airplane it takes more thrust to take off and climb than to maintain straight and level flight at a constant airspeed and a constant altitude.

But once you are in straight and level flight, and you want to fly at a constant speed and a constant altitudec

Thrust must equal drag, just as lift must equal gravity.

So let's find out what drag is.

Try to stand up in a high wind and you will realize how much force moving air exerts against your body. When an airplane moves rapidly through the air, it has the same effect as if the air were flowing at that speed against the airplane. It tends to hold the air-



- 1. You have to have thrust enough to overcome all the resistance (drag) that is built up as you move your airplane through the air.
- 2. Then you have to have enough additional thrust to start your airplane, build up speed, take off, and climb.

(It is important to remember that, because of what happens when your wing moves more rapidly plane back, or lower its speed. All that force that the air exerts against the airplane is called drag.

Some drag is useful. Some of it we would like to get rid of-it is merely dead drag.

Dead Drug and Streamlining

Anything on an airplane that has a surface exposed to the air gives the air something to push against and therefore creates drag. Airplane designers, of course, have studied the effect of wind on various shapes and forms and have discovered those forms which offer the least resistance to the air. We call such shapes streamlined, and as far as possible everything on an airplane is streamlined. In that way we reduce dead drag.

Useful Drop

But we can never get rid of all drag, for some of it is useful. The thrust that we use to pull the wing through the air so as to produce lift creates useful drag. It is one of the forces necessary to flight. So, no matter how well we streamline the design of an airplane we always have to have thrust and drag.

 If we have more thrust than drag we begin to accelerate (go faster). 2. If we have more drag than thrust we begin to decelerate (go slower).

 If we have exactly the same thrust as we have drag, we keep a constant speed at a constant altitude.

You have experienced these conditions in an automobile. Thrust in a car is the force that the engine exerts to drive the car forward. Drag is the friction and wind resistance of the car. You step on the gas to speed up—that is, increase the thrust until it is greater than the drag. Your car goes faster.

If you take your foot off the gas, you slow down because your thrust is less than your drag.

When you want to cruise along at the same speed on a level highway, you hold a constant throttle setting that gives you an exact balance between your thrust and your drag.

THE FORCES OF FLIGHT

In the flight of any airplane, then, we have these four forces at work: Lift, weight, thrust and drag.





Before an airplane can be designed to fly, it must be so built as to balance the forces applied upon it in flight. In other words, it must be stable, and it must be controllable. It must tend to fly straight and level, without requiring the pilot to keep it on an even keel by main force. At the same time, it must be so built that the pilot may move it left or right, up or down, or from one side to the other at will. Inherent Stability

In building model planes you have discovered that before they will fly they must be balanced. The distribution of weight is important.

A plane that is tail-heavy or nose-heavy or onewing-heavy is badly balanced.

The center of gravity (as it is called) must be figured so that it is very near to the center of lift. That is the first consideration for inherent stability (which merely means built-in stability).

The second thing that must be built in is some control that will keep the airplane flying straight and level.

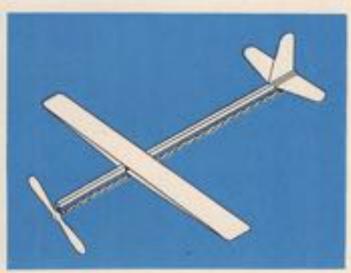
If you take a sheet of paper and skim it through the air, it will fly in an erratic and unpredictable way, but it won't go straight. If you fold it into a dart shape, it will do better, but it will still twist and turn and roll erratically. It has only a little inherent stability.

A carefully built model airplane, however, flies straight and level unless and until it gets blown about by air currents.

The stabilizers you build into a model airplane are the same in principle as those built into any airplane.

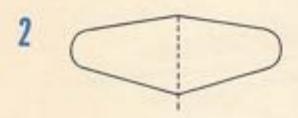








The vertical stabilizer is a fixed airfoil in the tail which stands vertically. It holds the airplane from turning left and right.



The horizontal stabilizer is like a small wing built horizontally into the tail. It holds the airplane from nosing up and down.

There is still another way an airplane can move it can roll, wing down or up. The wings are so constructed and so placed on the airplane that they tend to keep the airplane stable in that direction.

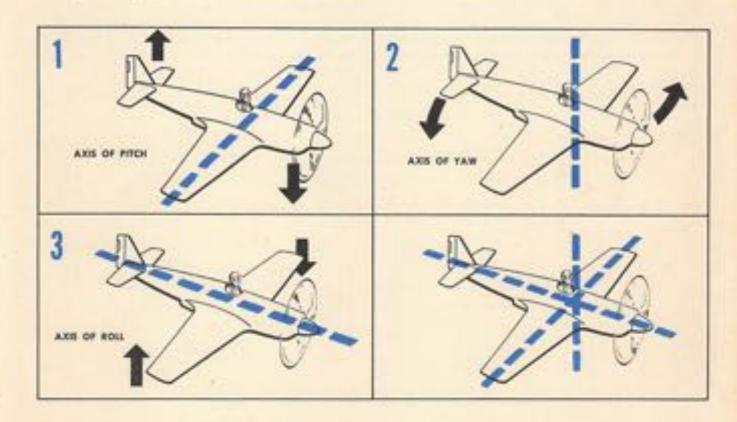


The Axes of Rototion

You can see that an airplane can turn in three planes, whereas an auto, for example, turns only in one, left or right. Think of an airplane as having three axes of rotation.

Take a piece of cardboard and cut it into a rough airplane shape. Then follow this explanation:

- Turn to the left or right around the vertical axis. That is called the axis of yaw. That is the axis you can turn an auto in.
- (2) Put the nose down and the tail up, or the nose up and the tail down. That is called rotation about the axis of pitch. By controlling that rotation you put an airplane in the proper position to climb or dive.
- (3) Now roll the left wing down and the right wing up, or the other way around, and you have rotation about the axis of roll.



Control Surfaces

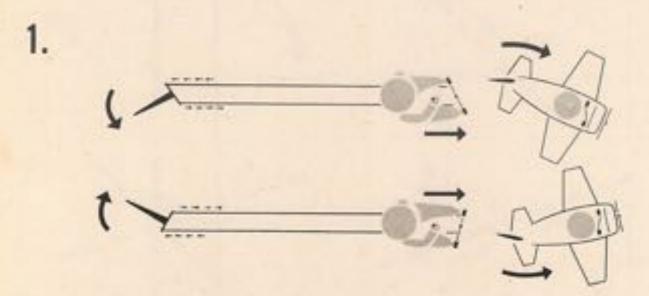
CONTROLS

three axes—the axis of pitch, the axis of rell, and the axis of yaw—movable control surfaces are used.

RUDDER

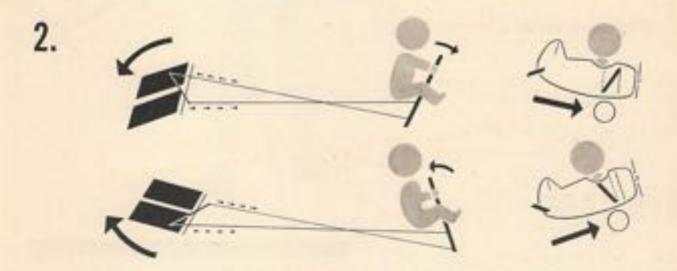
Movement around the axis of yaw is controlled by the rudder, which answers to pressure on the rudder pedals. When pressure is applied to the right rudder pedal, the nose of the airplane moves to the right. When pressure is applied to the left rudder pedal, the nose of the airplane moves to the left.

To control the flight path of the airplane around its



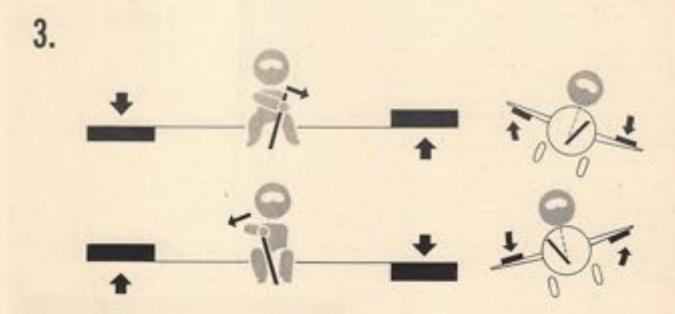
ELEVATORS

Movement around the axis of pitch is controlled by the elevators. The elevators answer to forward and backward pressures on the stick. When forward stick pressure is applied, the nose of the airplane is lowered. When backward pressure is applied, the nose of the airplane is raised.



AILERONS

Movement around the axis of roll is controlled by the ailerons, which answer to sideways pressures applied to the control stick. Pressure applied to the stick toward the left depresses the left wing. Pressure on the stick toward the right depresses the right wing. The ailerons are so linked together by control cables that when one aileron is down, the opposite aileron is always up. In other words, pressure on the controls forces one wing down and the opposite wing up at the same time, and thus governs the movement of the airplane around the axis of roll.



Coordination of Controls

Control pressures are selden used separately. The simplest maneuver needs coordination of all three pressures. A simple turn to the left requires coordinated pressures on ailerons, rudder, and elevator.

TRIM TABS

Even though an airplane has inherent stability, it does not always tend to fly straight and level. You remember we told you that the weight of the load and how it is placed in an airplane affects its stability. Various speeds also affect its flight characteristics. If you use up the fuel from one wing tank before you use it from another, your plane wants to rell toward the full tank. All of these variations require a pilot to exert pressure on the controls to correct for them.

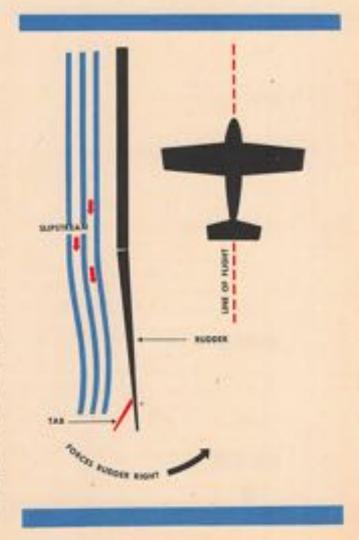
While climbing or while gliding, it is necessary constantly to exert pressure to keep the airplane in the attitude you want.

Such constant control pressure is tiring in a small plane; it is exhausting in a medium-size plane; it is impossible for any length of time in a heavy plane.

So airplanes are constructed with trim tabs, as they are called. These are really nothing but small, hinged, control surfaces on the main control surfaces. You can move them up and down by means of a crank or reel in the cockpit. An ingenious system of control wires lifts them up or drops them as you will. By using them you can balance the forces on the controls so that the airplane will fly straight and level with your hands off the controls. Or you can set the tabs so that the airplane will maintain a climbing attitude or a gliding attitude.

One of the most interesting things about trim tabs is that they actually work like control surfaces of controls. That is, if the rudder tab is set toward the right it pushes the rudder to the left, and thus makes the airplane yaw to the left.

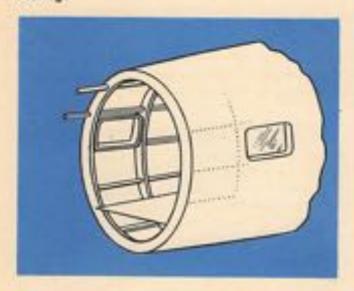






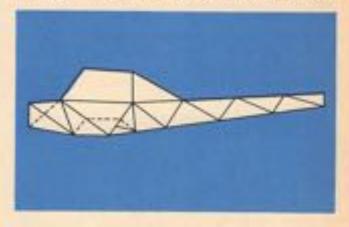
Aircraft are built of the strongest, lightest materials that can be procured. Before special-strength, lightweight metals were developed, planes were constructed of wood and fabric. On some small airplanes, these materials are still used in wing construction. But metal is better than wood because it is stronger and does not deteriorate as fast. It is more resistant to fire, and it does not change its shape and size under pressure or changes of weather.

Fuselage



The body of the airplane we call the fuselage. It is like the body of an automobile because it houses the cargo, passengers, and crew. But there is no heavy chassis in an airplane. Instead, the strength is built into the entire structure. The lengthwise members are called stringers, The cross-section members are called ribs. When the lengthwise stringers and the cross-section ribs are joined together, you have the skeleton of the fuselage. This construction provides only a fairly rigid frame. However, when the metal skin is fastened over these stringers and ribs with hundreds of small rivets the fuselage becomes rigid and strong. This is the modern or stressed-skin method of fuselage construction.

In older aircraft and in some light airplanes today, a slightly different fuselage construction is used.



Instead of many stringers of light weight, a smaller number of heavier members are used. They are called lengerons. The cross members, or ribs, are also fewer and much heavier. This framework, strong within itself, is covered with fabric, which is then painted with a special preparation called dope. Dope shrinks the fabric, drawing it taut over the framework so that it adds some strength to the whole structure.

WINGS



There are three parts of the wing:

- 1. The wing tip.
- 2. The wing section.
- 3. The center section.

These three sections are sometimes built separately—particularly in modern all-metal planes—then fastened together when the wing is assembled. The tip is usually the portion beyond the alleron. The wing section is the portion between the wing tip and thecenter section. The center section is often part of the main body of the airplane where the wings are fastened to the fuselage.

Wing Construction

There are only two main types of wing construction used today:

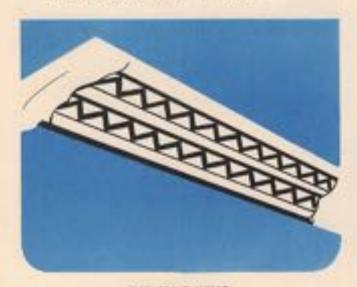
- 1. The spar wing.
- 2. The braced stressed-skin wing.

The spar wing has heavy spars extending the length of it. These spars, whether they are "I" beams or cross-braced, carry the load.

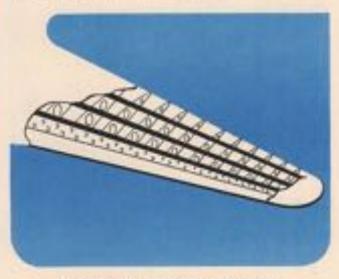
The braced stressed-skin wing is made much like the modern stressed-skin fuselage. Smaller sections are riveted together.

Each of these sections is cross-braced, like a section of a cantilever bridge. Then the whole series of sections, after they are joined, are covered with thin sheets of light but strong metal that are riveted over the semi-rigid structure.

From such construction we get a strong semi-rigid structure. It actually has more give to it than the spar wing and that give or play in the structure is important. It absorbs the violent shocks that planes in flight are sometimes subjected to. It is somewhat like the springs on your automobile.



THE SPAR WING



THE BRACED STRESSED-SKIN WING



Before you can fly an airplane you must be able to taxi and take off. Then you must land it again and taxi along the ground to its parking place.

Even in normal operations, the landing gear has to withstand great loads and the landing shock. It is designed to stand these heavy loads. It is not, however, made to stand heavy side loads. That is why pilots are taught the importance of landing with a straight landing track. Even a slight amount of drift during a landing places great side loads on the landing gear.

Tricycle Landing Gear

There are only two types of landing gear:

- 1. The modern tricycle gear.
- 2. The conventional 3-point landing gear.

The modern tricycle gear has great advantage over the old or conventional gear because once the airplane is on the ground it tracks straight and true. It consists of two main landing wheels and a nose wheel that operates on a full-swiveling caster. The airplane is always landed on the main wheels. You use the nose wheel only for ground operation. After landing, and as you slow down, the plane settles gently on the nose wheel. That's because the main landing wheels are behind the center of gravity.

The conventional landing gear is still the most commonly used. It consists of two main landing wheels, placed in front of the center of gravity, and a wheel at the tail.

When such a plane lands, it settles with its tail down, since there is more weight behind the landing wheels than there is in front of them. The pilot then has some control in turning left or right on the ground because the tail wheel is usually steerable. It is hooked up to the rudder pedals in such a way that as you press the right pedal the plane turns to the right, and vice versa.



THE MODERN TRICYCLE LANDING GEAR



THE CONVENTIONAL 3-POINT LANDING GEAR



As you study you will learn about many instruments. Later, if you take flying training and begin your progress through Primary, Basic and Advanced schools, you will understand just what one Aviation Cadet meant when asked by his instructor what he thought of the instrument panel of a fighter airplane.

"It looks, sir," he said, "like the Grand Canyon full of alarm clocks."

Magnetic Compass

All airplane instruments are important. But remember this: The magnetic compass is the most important instrument in the cockpit. You will learn more about it in the section called How to Find Your Way in the Sky.

Purpose: To indicate the heading or direction in which the airplane is flying.

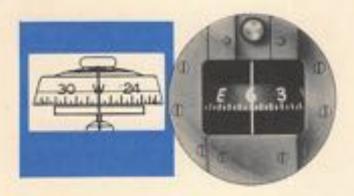
Principle: The earth acts as a huge magnet. The



north magnetic pole is near the geographical (true)
North Pole and the south magnetic pole is near the
geographic South Pole. A freely suspended bar
magnet will swing until one end points to the magnetic north pole. That is the principle of the magnetic
compass, the direction-indicating instrument in your



Description: An airplane's magnetic compass consists of a metal bowl filled with a liquid. Resting on a pivot inside this bowl, free to rotate, is a saucerlike dome. It carries a set of magnetized needles and a circular scale indicating North, South, East, and West. All other directions of the 360° are marked with lines at 5° intervals. The magnetic needles within the dome always seek to line up in the North-South direction. When the plane turns, the dome stays in the same N-S direction, and the plane heading can be read against a line through a window.



Compass Errors

The compass is an accurate and dependable instrument in the hands of the pilot or navigator who knows how to use it. But it is subject to two types of errors:

- 1. Inherent errors.
- 2. Flight errors.

Inherent errors must always be considered whether you are using a compass for a hike through the woods, on a boat at sea, or in an airplane. They have nothing to do with flying itself.

Variation is caused by the fact that the earth's magnetic poles do not coincide with the geographic poles. The amount of variation is the difference in angle between the directions of true north and magnetic north.



U. S. COMPASS VARIATION

Aeronautical charts show the amount of variation for every section over which you may fly. The lines of equal magnetic variations are called isogonic lines. Deviation is caused by nearby magnetic sources in the plane, such as the proximity of iron parts and the electric current in the radio or electrical system. Deviation is greatly reduced by compensating mag-



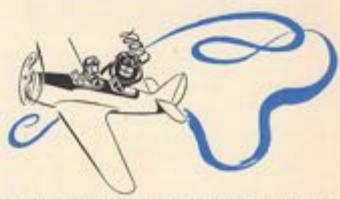
nets so placed in the compass case as to counteract the effect of the stray magnetism in the airplane. It is seldom possible, however, to eliminate deviation completely. The amount of deviation the pilot has to reckon with in figuring headings is stated on the compass card installed on the instrument panel.

This card is filled in after the compass has been installed and swung to find its deviation errors.

All the compass errors we have discussed have been inherent errors of all magnetic compasses. Note that variation is a property of a location while deviation is a property of the airplane.

Flight Errors

In an airplane there are other compass errors known as flight errors. The lines of magnetic force of the earth are vertical at the poles and horizontal at the equator. Thus, at the equator, a compass works best.



At the poles the lines of force, being vertical, are pulling the needle down. As long as an airplane is flying straight and level, the compass is accurate. But when the airplane banks and turns, the vertical magnetic force causes the instrument literally to "go crazy." It spins, often in the wrong direction, and it swings back and forth unable to make up its mind as to what direction the airplane is heading.

A good pilot always makes one simple preflight compass check. He lines up his plane in a known direction and checks his compass reading. Altimeter



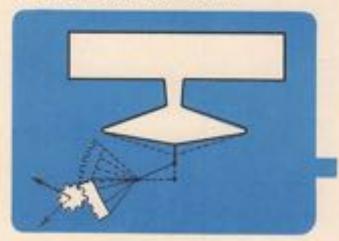
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spring from

Purpose: The altimeter records the height above sea level.

Principle: The altimeter is a type of barometer reading altitude in feet. Its design is based on the fact that air pressure decreases evenly with increase of altitude. You will learn more about this fact in the section called Your Body in Flight.



Description: An altimeter consists mainly of a case open to the atmosphere. Inside the case there is an airtight metal chamber filled with normal air at normal pressure. When the plane is at sea level, the pressure in the outer case and in the chamber is the same. As the plane gains altitude, the pressure in the case decreases. The pressure in the chamber, however, remains the same. This creates a condition in which the pressure in the chamber is greater than the pressure in the case. By means of a sensitive



diaphragm and a gear mechanism the pressure difference is indicated on the dial as altitude in feet. Errors: Because the altimeter is a barometer, it is affected by the change of barometric pressure and must be set for the prevailing barometric pressure to give accurate results. This is done by a knob which turns the dial hands.

On the ground, the altimeter can be set to show the altitude of the field. This corrects the instrument for the prevailing barometric pressure. The altimeter will show the correct altitude above sea level until the barometric pressure changes.

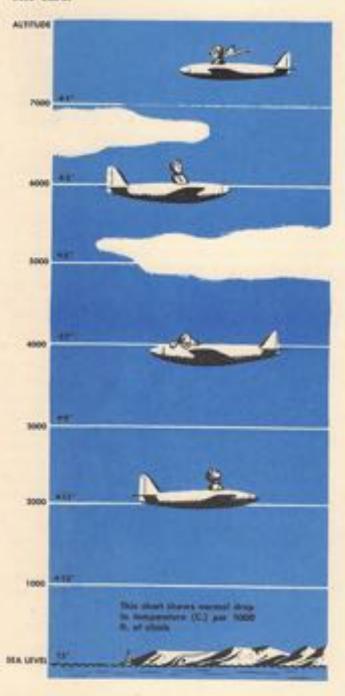
Some altimeters are equipped so that the setting can be changed in the air. For this purpose a small setting window on the face is provided. The pilot obtains the prevailing barometric pressure by radio and resets his instrument accordingly.



Temperature Errors: The altimeter is also affected by change of temperature. It is designed for normal temperature (15° Centigrade) at sea level pressure. A built-in correction takes care of the normal 2° drop in temperature for each 1000 feet gained with temperature normal at sea level.

Thus, if the temperatures are higher than usual, your altimeter will indicate a lower altitude than you are flying. This is not dangerous because accidents never occur because you fly too high over a mountain.

But if temperatures are lower than normal, use raution because your altimeter will indicate a higher altitude than you are flying. These corrections are made by the pilot with a computer or with an altimeter card.



Preflight Check: Check the setting knob and tap the instrument with your finger to be sure the needle is free.

Before takeoff, set altimeter to field elevation.

Airspeed Indicator

Purpose: The airspeed indicator shows the speed at which the airplane is flying through the surrounding air. Its greatest use to the pilot is warning him to stay within safe speed limits between the minimum speed (stalling speed) and the red line or maximum allowable speed limit of the airplane.

It also helps the pilot to compute ground speed.

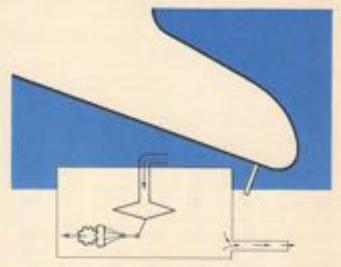


Principle: The airspeed indicator depends on a pitot tube that delivers two kinds of air pressure to the instrument itself:

- Dynamic air pressure (impact pressure created by the motion of the plane).
- 2. Static air pressure (prevailing air pressure).

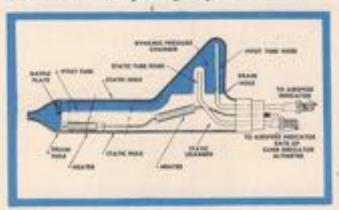
Note that there is no flow of air through a pitot tube.

The airtight case of the instrument is connected with the static pressure line of the pitot tube. A



disphragm inside the case is connected with the dynamic pressure line of the pitot tube.

When the plane is in motion, there is an impact of air creating dynamic pressure. This pressure increases as the speed increases. As the impact pressure increases, the diaphragm expands and the needle connected by a gear mechanism shows the corresponding airspeed on the dial.



Errors: As you climb in the sky, the air becomes thinner and the temperature drops. These changes cause your airspeed indicator to deceive you. It is a reliable and accurate instrument, but it was built to read correctly only at sea level pressure and at 59° F. Therefore, at higher altitudes and lower temperatures, you have to correct each reading of it. The chart below shows you how much faster you are traveling at various altitudes than your airspeed indicator shows. It assumes temperatures based on the normal lapse rate.

Ordinarily, you will make the necessary corrections with a simple computer which changes indicated airspeed into true airspeed. In the section, How to Find Your Way in the Sky, you are told how to do this.

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When your airspeed indicator reads						
	offer.	MANUTE.	10,000 01.	32 m	ann.	2000
100 mph	1071/2	116	126	137	149	163
150 mph	161	174	189	205	224	245
200 mph	215	233	252	274	298	327
250 mph	269	291	315	342	373	408
300 mph	323	349	377	410	447	490

Preflight Check: The pilot's preflight check is simple. On the ground the needle will rest at 0, unless there is a strong headwind.





Purpose: The rate-of-climb indicator shows the vertical speed of the airplane. It indicates how many hundred feet per minute the airplane is climbing or diving.

Principle: The principle of this instrument is the steady decrease of air pressure with increase of altitude. The rate-of-climb indicator consists mainly of a case which is connected with the outside. As the airplane gains or loses altitude, the air pressure changes in the case. Inside the case there is a chamber, airtight except for a small calibrated leak. While the air pressure in the case changes with the change of altitude, the pressure in the chamber remains constant until it is equalized by the air leaking in through the calibrated leak. With the help of a sensitive diaphragm and a gear mechanism the resulting pressure difference, which is in proportion to the rate of climb or descent, is indicated on the dial.

An example will best explain the operation of this instrument. At sea level flight, the pressure in the case and in the chamber is the same. The needle on the dial points to zero. The airplane has no vertical speed. As the airplane climbs, the pressure in the case decreases, and the pressure in the chamber remains the same except for the minute flow of air through the small leak. There is now a higher air pressure in the chamber than in the case. The diaphragm expands and the needle points to the rate of climb on the dial.

This instrument has a lag of 7 to 10 seconds.



Preflight Check; The needle should show 0 on the ground.



In explaining the four forces that act upon an airplane in flight, we have taken it for granted that the airplane moved through the air at relatively high speed. Naturally it requires power properly applied to make it move.

We mentioned that model planes are usually powered by twisted rubber strands, which exert pressure on a propeller, making it whirl around fast enough to produce thrust.

In man's long struggle to conquer the air and fly, one of the chief difficulties he ran into for centuries was how to get power enough to make his contraptions take off the ground and stay in the air.

Though he tried flapping wings which he moved with his arms or legs, he could never produce enough power with his own muscular exertion to fly. Birds are able to fly because 60 per cent of their weight is muscles. But man, even if he could build efficient mechanical wings, could never produce enough power in relation to his weight to fly. Only about 8 per cent of his weight is made up of muscles.

It was necessary to devise some powerplant that could produce a great deal of power and still weigh relatively little. We express the relation between the weight and the power of an engine in terms of pounds per horsepower. For instance 2 pounds per horse power, 1½ pounds per horsepower, etc.

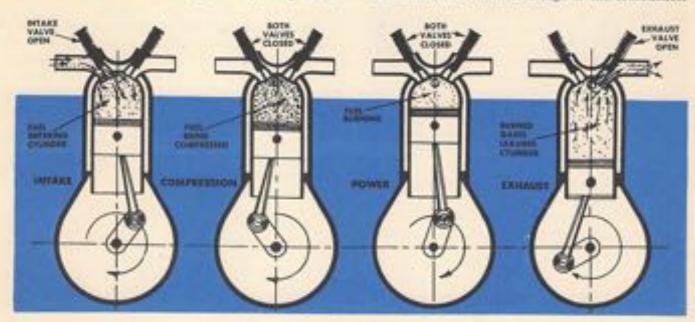
It was not until the invention of the internal combustion engine that we had an engine capable of power enough per pound to make an airplane fly.

Powerplant

Nearly all aircraft engines today are 4-cycle reciprocating internal combustion engines.

Four-cycle engines are so called because there are four cycles or events that must occur for each power impulse.

 The first stroke is called the intake or admission stroke. The piston moves outward, or toward the crankshaft, and draws a charge of the combustible.

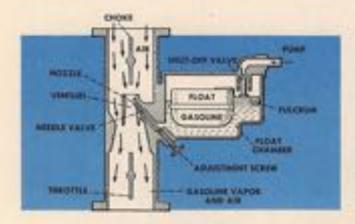


mixture into the cylinder. During this stroke the intake valves are open.

- The second stroke is known as the compression stroke. The piston moves inward or away from the crankshaft, compressing the charge. At the end of the compression stroke the spark occurs and ignites the charge. During this stroke, both intake and exhaust valves are closed.
- 3. The third stroke is known as the expansion or power stroke. The hot ignited gases create a high pressure on the piston and again move it outward, or toward the crankshaft. Near the end of the stroke the pressure is much reduced by expansion, the exhaust valve opens, and the burned gas starts out of the cylinder.
- 4. The fourth stroke is known as the exhaust, or scavenging stroke. The piston returns inward, or away from the crank, and forces the burned gases out of the cylinder. At the end of the fourth stroke, the piston again moves outward, admitting another charge of fuel and air mixture, and starting another similar cycle of events.

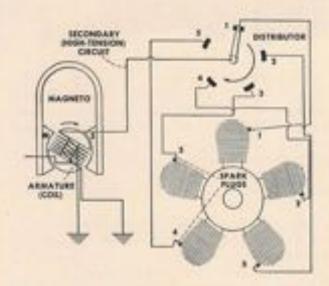
This is the basic understanding of the airplane engine. Later on in your training you will study engines thoroughly. All the new developments such as fuel induction, moisture induction, supercharges, and other improvements on this basic combustion engine will be covered at that time.

Carbureters



Contrary to popular belief, the engine does not burn fuel alone. It burns a mixture of air to which a small amount of vaporized fuel has been added. The carburetor's only function is to mix this large quantity of air with the correct small quantity of fuel for delivery into the cylinder. It accomplishes this in the Venturi tube of the carburetor where the incoming air is restricted and consequently travels at a high velocity. At this point, the raw fuel becomes a fine spray and travels directly to the cylinder. The high velocity of the air passing through the Venturi tube causes a reduction in the temperature of the air. This, coupled with certain atmospheric conditions, will sometimes cause carburetor ice. Carburetor ice is a subject you will be taught later.

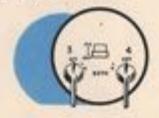
Ignition System



The ignition system delivers high-amperage, lowvoltage current to the spark plugs which, in turn, ignite and fire the charge of air and fuel that drives the engine. Aircraft engines have double ignition systems for two reasons: (1) added safety in case one system or one plug is fouled, and (2) better combustion and smoother engine operation.

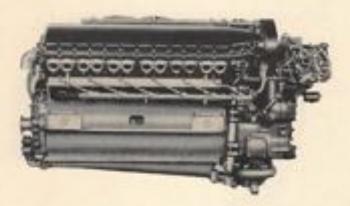
One of the musts that every pilot obeys before takeoff is to make an ignition or magneto check. The brakes are set, the stick held in the full-back position, the throttle advanced to somewhat under cruising rpm's, and each of the separate ignition systems is tested. After testing, the switch must be returned to the BOTH magneto position.

If the pilot finds rough or faulty engine operation on either of the ignition systems he returns to the flying line and does not take off.



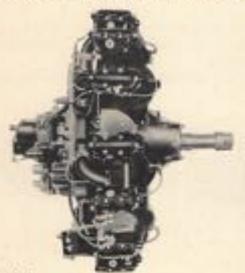
Liquid or Air-Cooled Engines

Two types of engines are in common use in our firstline military aircraft today.



1. Liquid-cooled

A liquid-cooled engine is jacketed around the cylinders. A liquid coolant is circulated to absorb the heat and transfer it to the air through a radiator located somewhere in the slipstream of the airplane.



2. Air-cooled

Air-cooled engines are, in themselves, direct radiators. They radiate their heat through a series of fins and radiating surfaces into the airstream and are cooled in this direct way.

There is a never-ending discussion between pilots and engine designers as to which is the more efficient engine—the air-cooled or liquid-cooled. Both types are considered to be equally good by the Army Air Forces. The liquid-cooled engine offers better streamlining possibilities. The air-cooled engine generally has a higher horsepower-to-weight ratio. Generally speaking, the advantages and disadvantages of these two types of powerplants equalize themselves.

Types of Engines



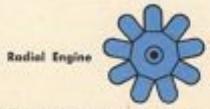
The cylinders of the in-line engine are arranged in a single row on the crankcase, sometimes in an upright position, but preferably in an inverted position. This type of powerplant is not suitable for high horsepower engines, but is reliable and satisfactory for low-performance airplanes. An in-line engine is usually limited to 6 cylinders to facilitate air-cooling and to avoid too much weight per horsepower.



The cylinders of the V-type engine are arranged on the crankcase in two rows or banks forming a V. This arrangement greatly reduces weight per horsepower because both banks of cylinders utilize the same crankshaft.



In the opposed engine, the cylinders are arranged horizontally in two rows on opposite sides of the crankcase. A single crankshaft is employed. Because of the flat shape of the engine, it offers good visibility. It also is especially adaptable for streamlining and is used particularly on lightweight airplanes. Because of its flat shape, it is also adaptable to larger aircraft for installation in the wing.

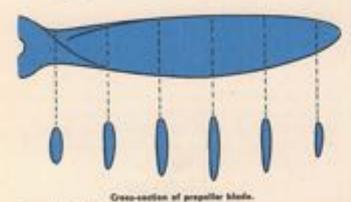


Radial engines are built in single or double-row de-

signs. The engine is particularly efficient because it uses a single throw 360° crankshaft to which all of the connecting rods are attached. This results in a minimum number of weeking parts and saving in weight. All modern airplane engines are reliable, dependable sources of power. A good pilot has a healthy respect for proper engine maintenance. In fact, you can paraphrase the old saying this way: "A pilot's best friend is his motor."



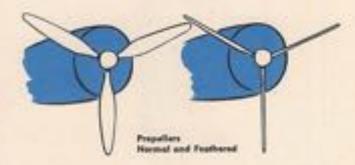
The purpose of the propeller is to transfer the power of the engine into forward thrust. The propeller is a revolving airfoil. It develops its forward thrust in exactly the same manner that the wing develops its lift. It has a leading edge just like a wing, the top is cambered just like a wing, and the bottom is a nearly flat surface. The propeller consists of one or more blades fastened to a rotating hub on the end of the engine crankshaft.



Propeller Pitch

Depending on the engine's rpm's, the propeller blades are set at a certain angle of attack or pitch to transform engine power efficiently into forward thrust. Most lightweight airplanes have fixed-pitch propellers. On larger airplanes and Army Air Forces tactical airplanes, this propeller pitch or angle of attack of the propeller blade is controllable from the cockpit.

Thus, if the pilot desires a high cruising speed and



low engine rpm he places the propeller in full high pitch (low rpm), causing the blades to take a bigger bite of air. For takeoff, controllable-pitch propellers are set at their lowest angle of attack (to take a smaller bite of the air) for a quick surge of power necessary for the takeoff itself.

Constant-Speed Propellers

Another refinement is added on large aircraft and Army Air Forces tactical airplanes, It is known as the constant-speed propeller. It is both controllable and automatic. Once in the air, the pilot sets his propeller at the angle of attack at which his engine operates most efficiently. Then climb or dive, regardless of what he does, the propeller blades change their angle of attack automatically to maintain a constant engine speed.



Tachameter

The purpose of the tachometer is to indicate the speed of the engine crankshaft. It is calibrated in revolutions per minute and is driven directly from the crankshaft through a flexible cable. Faulty or rough engine operation can be determined by the tachometer. It is also used in larger aircraft to determine propeller speeds.



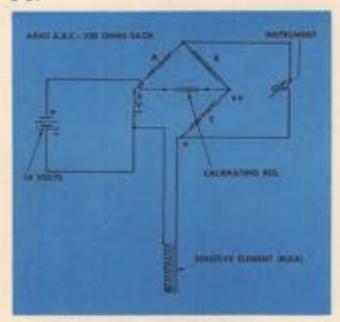
ENGINE INSTRUMENTS



Oil Temperature Gauge

The purpose of the oil temperature gauge is to aid in maintaining oil temperature within designated limits. Overheating of an air-cooled engine (unless it is equipped with head temperature gauges) can first be determined by consulting the oil temperature gauge.

Since airplanes must never be taken off until the engines are thoroughly warmed up, the oil temperature gauge is of paramount importance to the pilot just before takeoff,



The oil temperature gauge is a vapor-pressure thermometer consisting of three units:

- The bulb, which is located at the point of temperature measurement.
- The capillary tube, which connects the indicator with the bulb.
- The indicator itself, mounted on the instrument panel.

The bulb is filled with a volatile liquid which when heated changes into a gas and develops a pressure in the capillary tube. This pressure moves the pointer on the dial.

Minimum Engine Proflight Check

Using the engine instruments we have studied, a pilot of a light airplane should make the following minimum preflight check on his engine instruments:

- After starting the engine, he should want until the oil temperature gauge is within prescribed limits before taxing to the takeoff point.
- He should lock his brakes, slowly open the throttle to the prescribed limit and comult his tachometer to be sure his engine is developing full power.
- 3. He should then check his two separate ignition systems by turning the switch to each ignition system separately and then to both. If there is much of a drop in spin's on the tachometer on either of the ignition systems, he should not take off, but should taxi back to the flying line instead.

WHAT PLANES ARE THESE?





Check your answer on page 3.20





In the past 10 years tremendous advances have been made in airplane design and construction. We can confidently say that our engineers and designers have mastered the problems of aerodynamics and, so far as their contribution is concerned, have made flying as safe as driving a car. * Nevertheless, the airplane has not yet been built which can defy the elements. The weather on his path of flight is still the first consideration of a flyer and will continue to be for a long time to come. * In the fellowing pages you will learn much about the 3 hig factors which determine what the weather will be: moisture content, temperature, and pressure. Knowing that these factors produce weather and, especially, knowing what kind of weather various combinations of them are likely to create is as important to the flyer as the amount of fuel in his tanks.

IN THIS SECTION ...

Introduction

What the Science of Meteorology Is.—The 3 Layers of the Atmosphere.—The Tropopause.—The Gases Which Make Up the Atmosphere.—Three Important Factors Which Create Weather

Water Vapor and Particles

Explaining Humidity and Saturation Point—Part Played by Particles of Solid Matter in Process of Condensation

Temperature

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—What Conduction Is—Explaining the Lapse Rate—Temperature Inversion

Pressure

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Movements of the Air

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Moisture in the Atmosphere

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Explaining Ground Fag, Advection Fag, Upslope Fag.—When a Pilot May Expect Fag.—The 2 Types of Clouds to Remember.—The 3 Lovels at Which Clouds Farm.—What Various Clouds Are Called.— Terms Meteorologists Use to Describe Cloud Conditions

Stability

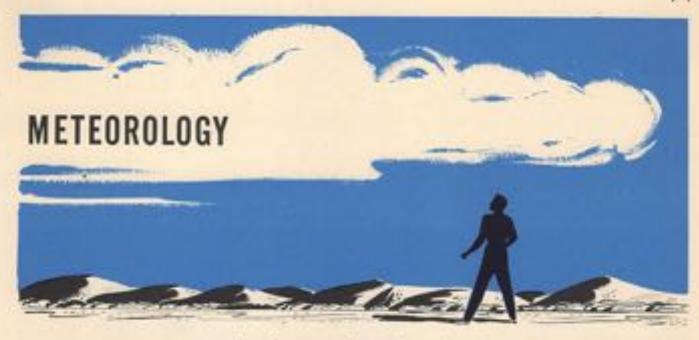
Effect of Stable and Unitable Air on Weather—Explaining the Adiabatic Lapse Rate—How Unitable and Stable Conditions of the Air Are Created

Air Masses and Fronts

Defining on Air Mass—Toble of North American Air Masses—Characteristics of Cold and Warm Air Masses—Werm and Cold Frontal Zones or Fronts

Weather Reports for the Flyer

What Each Weather Report Contains.—Sample Reports of a Single Afternoon.—Translating the Symbols Used.—How Pilot Interprets Reports in Terms of Their Influence on His Proposed Flight



Look up and watch a cloud moving across the sky.

Note its color, its size and shape, and the rate at which it travels. Then, with the help of a thermometer and barometer, you may be able to decide whether to expect rain, snow or good weather. If you can, you are an amateur meteorologist. You are able to interpret for your own use the signs in the sky or the atmosphere.

The science of meteorology is the study of the atmosphere and the things that happen in the atmosphere such as winds, temperature changes, and variations in moisture content. The cloud you see in the sky is the result of a number of those happenings in the atmosphere. They began a long time before the cloud was formed.

Simply stated, meteorology is the study of changing atmospheric conditions, commonly known as weather.

The atmosphere is the whole mass of air which surrounds the earth. It is most dense at sea level and grows less dense as its distance from the earth increases.

The atmosphere may be divided into 3 layers:

1. The troposphere

or lowest layer, extends to a height of about 8 miles above the earth's surface.

2. The stratosphere

or middle layer, extends to a height of about 60 miles above the earth's surface.

3. The ionosphere

or upper layer, extends to a height of more than 500 miles above the earth's surface.





TROPOPAUSE



There is a definite change in atmospheric activity between the troposphere and the stratosphere. The dividing line between these 2 layers of the atmosphere is called the tropopause.

Although certain small atmospheric changes do occur above the tropopause, the meteorologist and the aviator are primarily concerned with the troposphere.

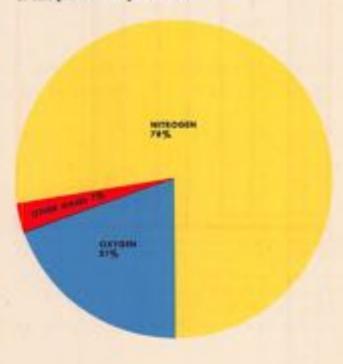
The troposphere is the weather region of the etmosphere.

The atmosphere is composed of a mixture of gases. By far the largest component of air is nitrogen, accounting for about 78 per cent of the total. Next largest is oxygen, with 21 per cent. The remainder consists of water vapor and small quantities of other gases such as helium and hydrogen. In addition, there are small quantities of salt crystals and other particles of matter, mostly dust.

It is important to remember that the amount of water vapor and particles of matter found in the atmosphere varies greatly. Its other constituents remain uniform in proportions at all levels.

Three important factors which create weather are: 1. The amount of water vapor and solid particles (salt crystals, etc.) present in the atmosphere.

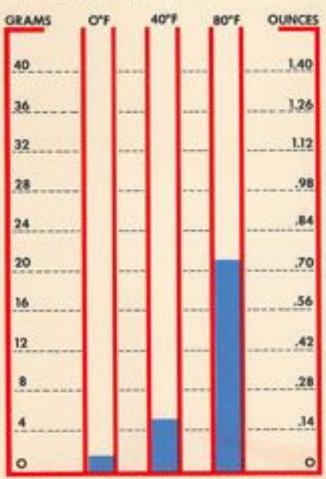
- 2. Inequalities in temperature.
- 3. Inequalities in pressure.



WATER VAPOR AND PARTICLES

The atmosphere derives most of the water vapor which it contains from the earth's supply of water in oceans, rivers and lakes; from falling rain and snow, and from plants. In regions where there are large surfaces of open water and where vegetation grows abundantly, water in large quantities is drawn off into the atmosphere in the form of vapor. In warm weather this happens to a greater extent than in cold weather. The summer is therefore a period when the atmosphere is rich in water vapor.

The amount of water vapor which the atmosphere contains determines its humidity.



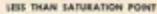
This chart shows the maximum amount of water vapor which a subir faut of atmosphere can contain at the respective temperatures indicated,

The process of water vapor rising into the air may be compared to the process of dissolving sugar in a glass of water. You can't see any change in the water until it has absorbed all the sugar it can contain.



When that point is reached and you add more sugar, it won't dissolve—the water has reached the saturation point. But if you heat the water it can dissolve more sugar—you have raised the saturation point.





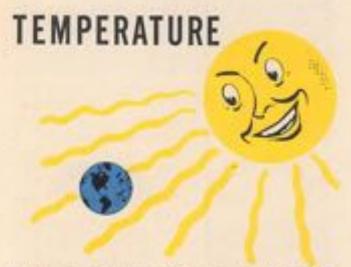


SATURATION POINT



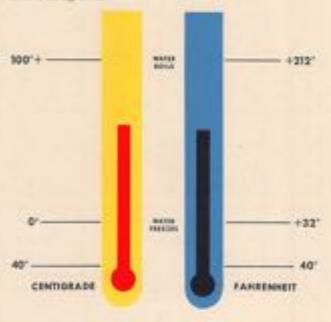
Similarly, when the air has received all the water it can contain, it has reached the saturation point. The amount of water vapor which the atmosphere can hold at any given time is determined largely by its temperature at that time. When air is heated, it can absorb more water vapor. When air is cooled, it won't hold as much water vapor. If there is more water vapor in the air than the air can hold, a certain amount of it will condense out.

The particles of solid matter which we mentioned above are important to the process of condensation. These particles consist of a number of impurities which are present in the lower atmosphere. They are mostly myriads of microscopic salt crystals (left when the sea spray evaporated). Over industrial areas and big cities, smoke particles are also present in large quantities. A red sun in the morning and evening indicates the presence of these particles in the atmosphere. They are important in the process of condensation because it is around them that the water vapor begins to condense into clouds, fog. rain or snow.



The sun is the furnace which operates the heating system of the earth. In the summer time its rays strike more effectively at the earth's surface than in the winter time. The heat produced by these rays is not equally distributed, however.

It is this unequal warming of the earth's surface which causes differences in temperature. These differences are directly responsible for changes in the weather. Temperature is measured in degrees. In the United States we use 2 scales of measurement, Fahrenheit and Centigrade.

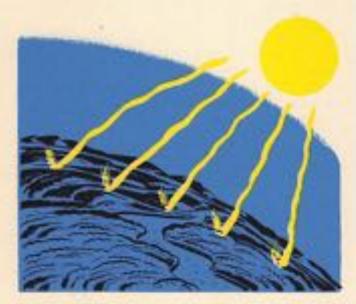


Convert Fahrenheit into Centigrade in the following way:

For the pilot, the following simplified formula will usually suffice: Deduct 32 from the number of degrees Fahrenheit and divide the remainder in half. For example, to convert 70 deg. F. to Centigrade, deduct 32 from 70, leaving 38. Then divide by 2 and you have 19 deg. Centigrade. While this is not strictly accurate, it is close enough for all ordinary flying problems.

The rays of the sun penetrate the atmosphere and warm the earth. This process is called radiation. Direct radiation from the sun does not heat the air appreciably. The air receives practically all its heat from the earth.

The chief process by which the air is heated is



called conduction. By this means, air passing over a hot surface gains heat in the same way that cloth wrapped around a hot iron absorbs heat from the iron. It is the actual contact of air and earth which produces the transfer of heat by conduction. This naturally means that only the lowest layer of air is



directly affected by the process.

As we ascend into the air, we find that the temperature normally drops. The rate at which it drops is called the lapse rate. With each 1,000 feet of ascent we find that, on the average, the temperature goes down 5½ deg. F (--2°C).





WHAT PLANES ARE THESE?





Check your secour on page 3-50

Sometimes, temperature rises with altitude. When this happens, the condition is called a temperature inversion.

Widely varying lapse rates are vital factors in the making of weather, particularly in determining the velocity of winds.



The pressure of the atmosphere fluctuates. At sea level, it averages about 15 pounds upon each square inch of the earth's surface. By means of the barometer we know that this pressure is equal to that of approximately 30 inches of mercury.

On weather maps pressure units called millibars are used instead of inches of mercury. Thirty-four millibars are approximately equal to 1 inch of mercury. And 29.92 inches of mercury, which is the standard atmospheric pressure at sea level, is equal to 1013.3 millibars.

STANDARD AIR

The "standard air" at sea level is arbitrarily fixed by meteorologists at 29.92 inches pressure (1013.3 millibars) at 15°C (59°F). As we ascend into the atmosphere, the pressure dreps at an approximately even rate of about 1 inch of mercury, or about 34 millibars, for every 1,000 feet of climb. The higher we climb, the less dense the atmosphere becomes. In other words, although the atmosphere extends for hundreds of miles, if we ascend to approximately 3 miles above sea level, half of all the existing air in the atmosphere is below us.

To explain this in another way, as you will encounter it again in the section on Your Body in Flight, although nitrogen and oxygen are present in their usual proportions at 18,000 feet, only half the quantities are present. If we ascend to 36,000 feet, we find only about half as much as at 18,000. At higher altitudes, the lowering of pressure is more rapid.

Human beings, who are accustomed to breathing oxygen at the normal air pressure of about 30 inches of mercury, or 1,016 millibars, find it hard to breathe when their supply of oxygen is cut in half.

At an altitude of about 24,000 feet, an aviator will become unconscious unless he provides himself with an additional supply of oxygen.



writing in flight at soos ft
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ASCENT TO 25,000 FEET WITHOUT OXYGEN

THE BIG 3 OF WEATHER

Taken together, the moisture content of the air, the temperature, and the pressure form a round-table trio which makes the basic decisions on what the weather is going to be.

Movements of the Air

The movement of air is caused by 2 main factors:

- 1. Inequalities in temperature
- 2. Inequalities in pressure

We have learned that the sun does not heat all parts of the earth's surface equally. As a result, the air is unequally heated also.

Since warm air tends to rise, an air parcel warmer than its neighboring parcels rises and is replaced by cold air. The vertical movement of warm air is called a convection current. These currents are really winds blowing up or blowing down.

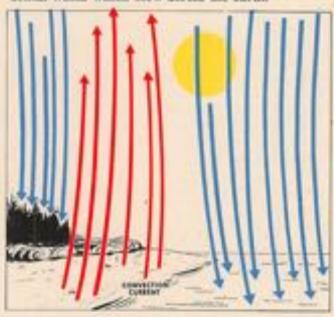
They are of considerable importance to the aviator, because these localized rising and falling currents push his airplane up and down suddenly and produce bumpy flight. The flyer calls it "turbulence."

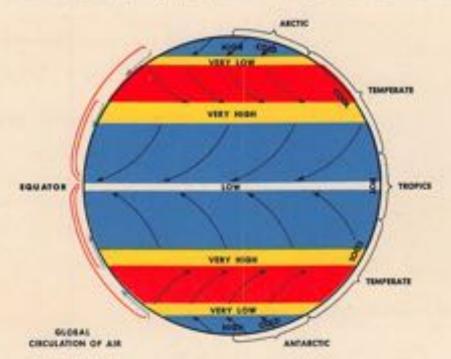
On a larger scale, inequalities of temperature cause what is called the global circulation of the air.

From the tropics, warm air is constantly rising and

moving towards the poles. Cold-air from the poles is constantly moving away from them.

These movements of air cause the prevailing horizontal winds which blow across the earth.





The prevailing direction of these winds is modified to a certain extent by:

- a. The rotation of the earth.
- b. Unevenness of the earth's surface.
- c. Distribution of land and sea areas.
- d. The passage of storms.

These 4 factors influence the general direction of the winds.

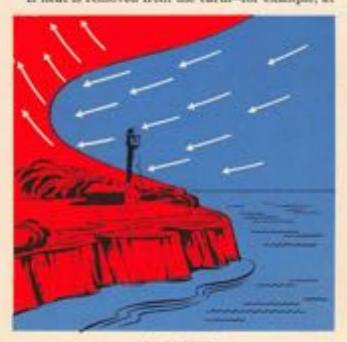


In localized areas, the different temperatures of land and sea create local winds. The land heats faster than the sea, and air over the land becomes warmer during the day than it does over the sea. Cooler (heavier) air from the sea moves in to take the place of the warm air, creating a sea breeze.

If heat is removed from the earth-for example, at

sundown—the earth cools rapidly. When land temperature falls below that of the adjoining sea, a land breeze is created. Cool air from the land flows out to take the place of the rising warm air from the sea.

The atmosphere has a basic tendency to stabilize itself around the earth. This means that the air tends to equalize its barometric pressure. If there is too



SEA BREEZE



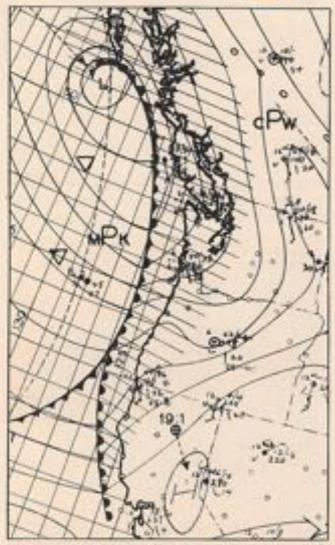
OFF-SHORE BREEZE

little air in one place (low barometric pressure) and too much air in another place (high barometric pressure) the air from the high pressure area tends to move toward the low pressure area. If the difference in pressure is great, the air moves faster. If it isn't so great, the air moves less rapidly. The difference in pressures between points in the 2 areas is called "pressure gradient." The speed or velocity of the wind is determined by this pressure gradient.

If the isobars, which are lines of equal atmospheric pressure drawn on a weather map, are close together this means that the pressure gradient is steep. High winds may be expected in that area.

The speed of wind is measured in miles per hour.

On weather maps meteorologists use the Beaufort scale to indicate wind velocity.



This is post of a typical weather map. It shows the meeting of arose of high and liew pressure, and the consequent creation of a front, over the west cannot of the United States.

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Beselve	Weather	Value by migh	General description	Specifications
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2	<u>_</u>	4107	Slight broase	Wind felt on face; leaves rante; ordinary name moved by wind.
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4	-	13 to 18	Madeutu bresst	Don't and been pager, small branches are moved.
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12	WA .	Above 25.	Hyrricana	

WHAT PLANES ARE THESE?





Check your enterer as page 2-28

MOISTURE IN THE ATMOSPHERE

We have learned that the amount of water vapor in the air varies. We have also learned that the amount of water vapor in the air determines its humidity.

In modern weather forecasting, humidity can be expressed as the dewpoint of the atmosphere. The dewpoint is a temperature reading. It is the temperature to which a given part of the atmosphere must be cooled to become saturated with water vapor.

The dewpoint of the air in your own home may be determined by a simple experiment. Take a thin metal pitcher partly filled with water and place a thermometer in it. Then add small pieces of ice. When the water and pitcher have been cooled to the dewpoint, small drops of water form on the outside of the pitcher. The temperature indicated on the thermometer when the drops begin to form on the outside of the pitcher is the dewpoint.

In other words, if the air in the room were cooled to the temperature shown on the thermometer it would be saturated with water vapor. If the room continued to grow colder, some of the water vapor would condense out in the form of water.

On a weather map, the dewpoint is always found next to the prevailing temperature. The difference between temperature and dewpoint is called spread.

If the spread is small, and cooling of the air is likely, fog or clouds may be expected.

Another way you may measure the amount of moisture in the atmosphere is by relative humidity. When air is saturated, we say that it has 100 per cent relative humidity.

Completely dry air (which is never found, however) would have a relative humidity of zero.

If we are told that the relative humidity is 50 per cent, it means that the atmosphere at a given temperature and pressure is holding half the water vapor it could contain under the existing conditions.

In the atmosphere, when a parcel of air has been cooled to and beyond the original dewpoint, the water vapor in the air condenses and forms clouds or fog.

This cooling process is caused mainly by:

- a) Convection. This is a rising current of air. As the air rises, it expands and cools considerably.
- b) Radiation. After sunset, the ground loses its heat rapidly. The loss of heat is partially determined by the nature of the ground. For example, rocks and

sand lose their heat more rapidly than wooded areas or swamps.

c) Advection. This is the inflow of warm air over a cold surface; for instance, air off the Gulf Stream flowing over the Labrador current.

FOG

Fog may be defined as a cloud on the ground. It often forms at night as a result of the air cooling by its contact with the ground to such an extent that the air becomes saturated. That is, it won't hold any more water.

Ground fog. This type of fog forms on a surface air-cooled during the night. It first appears in valleys and depressions as isolated patches, or, if the terrain is level, where saturation of air is greatest. Patches of fog join to form a layer which deepens until an hour or two after sunrise.



Advection fog. This fog develops principally in winter or early spring as a result of moist air drifting over colder ground or snow.

Upslope fog. This fog develops in uphill winds. It is a cloud resting on a slope or hill top.

A pilot may expect fog when temperature and dewpoint are only a few degrees apart. Fog is also likely in a widespread area of precipitation.





CLOUDS

Clouds are to the aviator what tracks are to the hunter.

Just as the hunter knows by its tracks what animal has passed and when, so the aviator, by studying the clouds, should be able to tell what unseen changes have taken place in the atmosphere to form those clouds.

Although a very elaborate classification of clouds has been compiled, it is sufficient for the pilot to classify them according to their shape or form and altitude. The 2 types of clouds to remember are:

- 1. Stratiform
- 2. Cumuliform

The 3 levels at which clouds form are classified simply as:

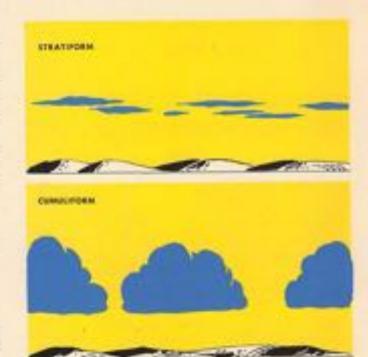
- 1. High
- 2. Middle
- 3. Low

Cumulus and stratus are generally low-level clouds. Altocumulus and altostratus are middle-level clouds. Cirrus, cirrocumulus and cirrostratus are high-level clouds.

On the low level, we also find nimbostratus, which is a stratus cloud forming in rain or snow, and stratocumulus, which is a wavy form of stratus. Cumulonimbus clouds are also found on this level.

Cirrus, cirrostratus and cirrocumulus are the





highest clouds in the sky. Because of the height at which they form they are always composed of ice crystals. Their presence in the sky often means had weather is coming.

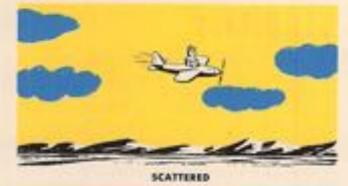
Altocumulus clouds, in the middle layer in the sky, are composed primarily of water. They are often associated with storms, sometimes with thunderstorms. Altostratus clouds, on the same level, are composed of ice and water. Rain or snow may be expected when they are present.

Stratocumulus, stratus and nimbostratus are the low layers of cloud. They are composed or water. In near-freezing temperatures, stratocumulus clouds are dangerous to an aviator because the water in them may accumulate on his airplane in the form of ice. Stratus are the lowest of all the clouds. They actually look like fog in the sky. When present, they may be accompanied by a drizzling rain. Nimbostratus clouds indicate persistent rain or snow.

Cumulus clouds do not belong to the layer type of cloud forms. They develop upwards, sometimes massing to great beights. In good weather they do not mass vertically but float as separate woolly tufts. When they begin to mass and develop upwards, forming towering cumulus, it is a sign that you may expect changing weather.

As they tower upwards, they may develop into cumulonimbus which produce showers and thunder-









storms. They are then known as "thunderheads."

Terms used by meteorologists to describe the cloud conditions of the sky are:

- 1. Clear. When there are no clouds present, or less than 1/10 of the sky is cloud-covered.
- 2. Scattered, When from 1/10 to 5/10 of the sky is cloud-covered.
- 3. Broken, When from 5/10 to 9/10 of the sky is cloud-covered.
- 4. Overcast. When more than 9/10 of the sky is

cloud-covered.

Clouds are the basis on which you determine the ceiling for flying. The ceiling is the distance in feet from the ground to the base of the lowest cloud covering more than 4/10 of the sky. If there are no clouds below 10,000 feet, the ceiling is unlimited. The ceiling is also unlimited if less than half the sky is cloud-covered below 10,000 feet.

If weather conditions reduce vertical visibility to less than 50 feet, the ceiling is zero.



STABILITY

Weather changes which occur depend to a very large extent upon whether the air over a given region of the earth is in a stable or unstable condition. When air is stable and dry, we may normally expect a period of good weather. In unstable air, we frequently have thunderstorms and the high velocity winds usually associated with them.

Generally speaking, we can determine whether we have a stable or unstable air condition by measuring the rate at which the temperature decreases with altitude (the lapse rate).

At this point it is necessary to consider how the temperature of a parcel of air is affected by vertical movement.

As you already have been told, when a parcel of unsaturated air rises it cools because of expansion at the rate of about 5½ degrees Fahrenheit per 1,000 feet. This rate of cooling is called the dry adiabatic lapse rate.

Another point to consider is that if a parcel of air has the same temperature as the surrounding parcels its weight will be equal to that of the surrounding air. If, on the other hand, an air parcel is warmer than its neighboring parcels it will weigh less than the adjacent air.

Parcels that are warmer than other parcels around them are buoyant and will rise. Parcels colder than those of their environment weigh more and will sink.

A rising parcel of air continues to rise only as long as it is warmer than the surrounding air. When it has risen and cooled to the temperature of the surrounding air it stops rising.

If the temperature of the surrounding air decreases more rapidly with altitude (a high lapse rate) than that of the rising parcel of air, the latter will rise more rapidly and to considerable altitude.

When this happens, vertical currents are likely and the air is said to be in an unstable condition.

On the other hand, if the temperature of the surrounding air does not decrease as rapidly with altitude as that of a rising parcel of air, the latter will rise slowly and to no considerable height. In this case, vertical currents are unlikely and the atmosphere is said to be in a stable condition.



UNSTABLE AIR CONDITION



STABLE AIR CONDITION



Pressure, humidity and temperature differences in the atmosphere are what cause weather. But the picture is not complete without a knowledge of the characteristics of the large masses of air which surround the earth.

When an extremely large parcel of the atmosphere is fairly uniform in temperature, humidity and pressure, it is called an air mass. An air mass is usually large, sometimes covering 1,000,000 square miles.

Air masses usually are not stationary. They move as single bodies, away from their sources of origin. They are affected by the surfaces over which they pass. Tropical air masses moving towards the poles are cooled. Polar air masses moving towards the equator are heated. When dry air masses move over a body of water their humidity increases.

Just as migratory birds tend to follow customary paths of flight with the changing seasons, so air masses tend to move along their customary routes at different seasons of the year. For example, cold polar continental air originates in northern Canada and moves southeastward across North America.



An air mass whose temperature in its lower layers is higher than that of the ground over which it passes is a warm air mass. An air mass whose temperature in its lower layers is lower than that of the ground over which it passes is a **cold** air mass.

AIR MASS CHARACTERISTICS

Cold Air Mass

- a. Turbulent air near the ground
- b. Good visibility
- c. Cumuliform clouds
- d. Showers, thunderstorms, hail, snow flurries

Warm Air Mass

- a. Smooth air near the ground
- b. Poor visibility
- c. Stratiform clouds
- d. Drizzle, mist, dew

FRONTS

We have learned that air masses move across theearth's surface. The zones in which cold and warm air masses collide are known as frontal zones, or fronts. They may be warm fronts or cold fronts. The impact of these air masses often results in extensive disturbances of the atmosphere.

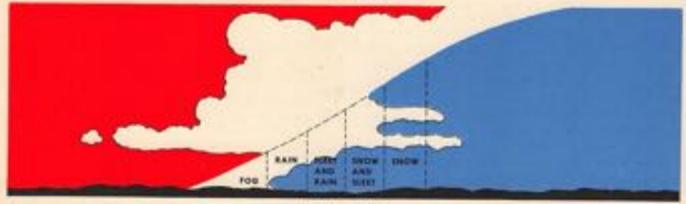
We know that cold air is heavier than warm air. Therefore a moving cold air mass, when it meets a warm air mass, pushes under the warmer air and lifts it to higher levels. When the cold air mass continues to exert this displacing influence against the warm air mass, the front is called a cold front.

When a warm air mass is moving towards a cold air mass and continues to push back and displace it, the front is called a warm front.

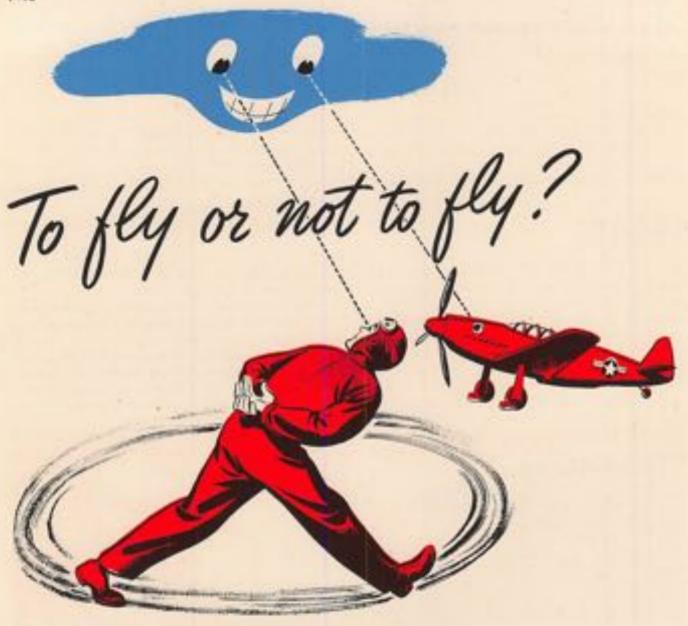
Sometimes, cold and warm air masses have properties very much alike. When these masses meet, a front may not develop. Instead, the two air masses merge with each other and do not necessarily bring on had weather.



COLD FRONT



WARM FRONT



At every airport throughout the United States hourly weather reports are available to the flyer. These reports are gathered by the U. S. Department of Commerce Weather Bureau from all parts of the country and are sent out over a teletype network to every airport on the circuit.

The report consists of the following items: Time of observation, ceiling, sky condition, visibility, current weather, obstructions to vision, barometric sea level pressure, temperature, dewpoint, wind direction and velocity, altimeter setting, remarks.

> Here are 3 sample weather reports on a certain afternoon:

CI C MAG @ /@ ATK - OSS/75/69 t 7/979/FQE VIVID LING SW INNU SE

TWE MPL MICH NW- TA/TO+/1/LTNG CLO TO CLO M

BN 871 400 40F- 061/76/74 1 15/978

And now we'll translate them for you

PIRST OBSERVATION

CG is the symbol for Chicago, Illinois; C is contact weather; M is measured ceiling; 60 is 6,000-foot ceiling; ⊕/⊕ is high overcast (above 9,750 feet) and lower broken clouds (at 6,000 feet); 4 is 4 miles visibility; T is thunderstorm; K— is light smoke; 085 is barometric sea-level pressure of 1008.5 millibars; 75 is temperature; 69 is dewpoint; 17 is wind south, 7 miles per hour; 979 is altimeter setting 29.79 inches; "fqt vivid liting nw thru ne" is an abbreviated version of "frequent vivid lightning northwest through northeast."

SECOND OBSERVATION

TWT is the symbol for Waterman, Illinois; SPL is special report (due to change of significance in weather); M is measured cailing; 30 is calling of 3,000 feet; © is broken clouds; RW— is light rain shower; 74 is temperature; 70 is dewpoint; 1/ 5 is wind north-northeast, 5 miles per hour; "Itag cld to cld e" is a condensed form of "lightning cloud to cloud east."

LAST OBSERVATION

BN is the symbol for Burlington, lowe; SPL is special report (due to significant change from earlier report); 40 is height of scattered clouds (4,000 feet); Ø is scattered clouds, 4 is 4 miles visibility; GF— is light ground fag: 081 is barometric sea-level pressure of 1000.1 millibars; 78 is temperature; 74 is dewpoint; in 5 is wind north-northwest, 5 miles per hour; 978 is altimeter setting of 29.78 inches.



By studying these reports for the stations along his line of flight and checking them with the weather map which is available at the airport from which he is preparing to depart, a pilot is able to forecast the weather to be expected en route.

For instance, if the spread between temperature and dewpoint at his destination is small, and he is flying late in the day, he may encounter fog on his arrival. (The ground cools rapidly at night and cools the air.) On the other hand, if he is due to arrive earlier in the day he may find that the spread has increased because the air has been heated by the warm ground. If he is flying from an area of high pressure to a destination where the pressure is low, he may find that the velocity of the winds has increased. The weather map will show him in which direction cold or warm fronts are moving and a glance at the weather reports from stations in the path of the front will indicate what is happening in those areas.

Forecasting the weather is a full-time job for a meteorologist. Though it is not necessary for a pilot to be an expert meteorologist, he will find that a working knowledge of weather and forecasting the weather pays off handsomely by increasing his confidence and making his flying pleasant and safe.

When a pilot starts out on a flight, there are 3 words which should always be uppermost in his mind. They are "Know Your Weather."



YOUR BODY IN FLIGHT

Because man does not take to the air neturally, like a bird, he has had to solve more problems than the principal one of finding a way to fly. When he rises from the ground, his body is almost immediately affected in a manner it rarely experiences on earth. As soon as he begins to move around in the sky his body is subjected to still other situations and conditions for which it is not naturally prepared. * For these reasons, a flyar's body must be unusually strong and rugged. In addition, he must know how to avoid or minimize harmful or distressing experiences in flight. A person who intends to fly cannot learn too early how to prepare his body for moving through the air at high speeds. * In the following pages, you will learn what happens to your body eleft and how best to condition yourself for the flying you hope to do.



IN THIS SECTION ...

Flying and the Inner Man

Conditions for Which the Human Body Wasn't Built—Varying Weights of Atmospheric Pressure at Different Altitudes—What Altitude Daes to The Air We Breathe—Physical Effects of Oxygen Lock— Two Ways to Avoid Anaxio—Gas Troubles at High Altitudes—How to Minimize Them—What Happens in the Midelle Ear during Ascent and Descent—Difference between Positive Acceleration (Positive G) and Negative Acceleration (Negative G)—Their Respective Physical Effects—What Governs Your Sense of Balance in Flight—How to Improve Night Vision

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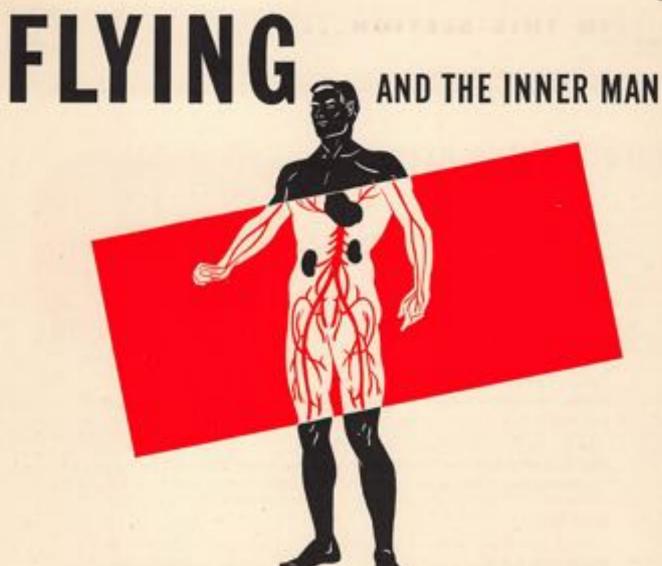
Its General Objectives—Importance of Attending to Most Serious Problems First—How to Stop Bleeding—How to Prevent Infectioe—Ways of Relieving Pain—What to Do About Froctures—How to Treat Burns—Symptoms and Treatment of Shock—Symptoms and Treatment of Frostbite—Artificial Respiration—How to Carry Injured Persons—Dangers of Exhaust Gases and How to Protect Yourself If You Detect Them

Physical Fitness and Requirements for Flying

Some Reasons Why Flyers Must Be Especially Fit—The Army's Rigorous Physical Examination for Flight Training—Compiling Your Medical History—Importance of Posture—Details of Examination— Standards of Height and Weight for Various Positions in AAF—Five Ways to Safeguard Your Vision—Proper Care of Teeth—What Comprises on Adequate Diet

Flying Safety

Pilot Errors Which Couse Most Accidents—How Majority of Accidents Hoppen—The Sensible Pilot's Attitude towards Safety—What the Shoulder Harness Is and Daes—Proper Care and Use of the Parachute—Items of Emergency Equipment the Wise Pilot Will Have on Hand



Your Body in flight

Victory in a sky battle often depends on how high you can fly, frequently on how fast you can fly. For that reason, our planes must be more powerful than the enemy's. Moreover, our pilots must be able to go higher into the blue and fly more cleverly than their foes. They must feel as strong, think as clearly, and see as keenly at 35,900 feet as they do at sea level.

Yet man was built to live on the ground. His body is not equipped to make up for the drop in atmospheric pressure and temperature changes which take place as he climbs into the air. If he is not protected against them, they can crapple his ability to fly and even threaten his life. He needs special knowledge, too, to minimize the terrific strain on his body when he darts and dives through the sky at a speed of 6 or 7 miles a minute.

Atmospheric pressure, as you learn when you study aerodynamics and meteorology, is the weight of the air. At sea level, it weighs about 15 pounds per square inch. At 18,000 feet, it is only half as heavy; at 33,500 feet, one-fourth as heavy.

This concerns us because it directly affects the amount of oxygen we get. Our bodies need oxygen just as an internal combustion engine does. Without it, the engine won't run and we can't live.

The air we breathe always contains the same relative amount of oxygen-21 per cent. But when we go up in an airplane and the atmospheric pressure goes down, the pressure of oxygen in the air drops, too. This is perfectly logical. Twenty-one per cent of 15 pounds per square inch is more than 21 per cent of 7½ pounds per square inch.

The latter figure, you remember, is the weight of air (atmospheric pressure) at 18,000 feet.

Now, at ground level, the pressure of oxygen in

the air is sufficient to supply what our bodies need. For peak mental and physical efficiency, we must keep our blood saturated with oxygen to the extent of 95 per cent. When the partial pressure of that life-giving gas drops, the percentage of it in the blood declines also. The effect is to lower our efficiency.

WHEN WE NEED OXYGEN...

At first, we don't notice oxygen lack. In fact, oddly enough, we generally feel exceptionally good. Almost immediately, however, an opposite effect appears. We can't see as well. We think less clearly and react more slowly. This condition is called exygen want, or anoxia.

Anoxia increases in severity as the body gets less and less oxygen. Unless the loss is made up, our minds become dull, we lose our memory, and our muscular centrol is poor. At 20,000 feet, great physical weakness sets in. We may have fits of laughing or crying. Extreme fatigue and sleepiness come on. Above 20,000 feet, most people lose consciousness and death may follow,

There are 2 ways of helping you avoid anexis in altitude flying. One is to adjust the atmospheric pressure artificially, keeping it about the same at high altitudes as it is on the ground. This has been done in pressurized cabins, and in flying suits and breathing



masks similarly equipped. Most are still, to a large extent, experimental. They are not widely used.

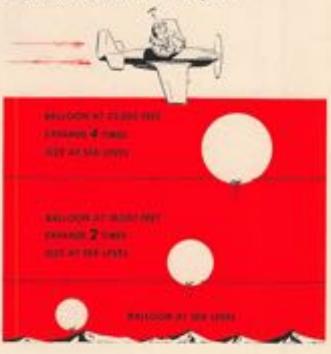
The other way, and a much more practical one, is to increase the percentage of oxygen in the air you breathe as you climb. Oxygen masks and apparatus accomplish this and that is why they have become so important to aviation in recent years.

GAS TROUBLES

Another unpleasant effect of increased altitude and lowered atmospheric pressure on the body cannot be offset artificially except in a pressurized cabin or some such device. That is the pain, sometimes acute, which body gases cause when they expand within the stomach, intestines, sinuses and middle ear. As outside pressure decreases these gases tend to increase in volume, like a balloon, and cause pain when they can't be released.

You cannot control this tendency entirely but you can do much to reduce its effects. Don't chew gues before making a high altitude flight. You swallow too much air. Avoid gas-producing foods, such as beans, cabbage, and carbonated beverages.

Not only do body gases expand when atmospheric



pressure decreases, but gases in solution in the blood and other fluids tend to escape and form bubbles. This reaction is similar to what happens when you take the cap off a bottle of soda. While the cap is on, the dissolved gas (carbon dioxide) remains in solution. When you remove the cap you reduce the pressure and bubbles quickly form.

At altitudes of 30,000 feet or more, the nitrogen in your body fluids forms bubbles, which appear in the joints and tissues. They may give you a great deal of pain in the joints (a condition called the bends), a feeling of weight on your chest, tightness or pain in your throat, or an itching or irritation of the skin. Sometimes these conditions are called aero-embolism. Remember that the more rapidly you climb, the higher you go, the longer you stay, the colder you get, and the more you exercise at great heights, the more likely you are to have these unpleasant feelings.

INSIDE THE MIDDLE EAR . . .

A third effect of increased altitude on the body usually results only in discomfort, but may be extremely painful. It occurs because of pressure changes within the middle ear. The middle ear is an air-filled bony space behind your ear drum. A slit-like canal, called the Eustachian tube, connects it with your throat.

As the air in the middle ear expands it pushes on the ear drum and makes your ear feel full. At intervals, while you're gaining altitude in a plane, the air slips out of the middle ear through the Eustachian tube. When that happens you hear a click. The pressure is then equal between the middle ear and the outside atmosphere.

When your plane descends, however, you have to make an effort to open the Eustachian tube yourself. You can do it by swallowing, yawning, or pinching your nose and blowing gently with your mouth shut. This process is called clearing your ears. It lets the outside air into the middle ear and equalizes the pressure again.

But when you have a head cold, the lining of the Eustachian tube is always swollen. It then becomes difficult or impossible to clear your ears in the way we've described. Yet, if you don't clear them when you are losing altitude in an airplane, you may rupture your ear drums. Therefore, don't fly when you have a cold. If you have to fly, stay low and climb and descend gradually.

Your nituses present a problem similar to that of the middle ear in flight. They seldom give you trouble unless you have a cold. Then, however, pressure changes on the sinuses cause great pain. That is another important reason for not flying under such circumstances.



POSITIVE AND NEGATIVE



Whenever you change the speed of an airplane or its direction, new forces act upon your body. The more sudden or sharp the maneuver, the greater the effect of these forces.

You've ridden on a roller coaster. Remember when it reached the bottom of a dip and started up? You felt as if you'd go right through the floor. The force that was acting on you then is the same one which affects a flyer when he makes a sharp inside turn or pulls out of a power dive. It results from positive acceleration and is called positive G. The letter G stands for gravity.

On the ground, at rest, your weight exactly equals the force of gravity exerted upon it. The symbol commonly used to represent this force is +1G.

However, in an inside turn or pull-out, the centrifugal force pushing you against the floor of the plane greatly increases your weight in relation to gravity. Sometimes it becomes several times as much as it normally is.

When this happens the blood is drawn from your head towards your feet. Its effect, varying with the amount of positive G, ranges from slightly impaired hearing and less efficiency at the controls to a darkening of vision or, for a short time, complete loss of sight (blacking out) and even loss of consciousness.

Blood surges in the opposite direction and rushes



into your head during negative acceleration, which produces negative G. Using the roller coaster example again, this is the force which affects you when the car races over the top of a rise and starts down. You suddenly feel that you have no weight at all and are about to fly off into space.

A flyer experiences this sensation, only to a much greater degree, when he does a sudden push-down or outside turn. As the blood is driven into his head, it threbs with pain; his eyes feel gritty and bulging. He may see red or even lose his sight completely (redding out) for a brief time.

A person can stand a great deal more positive than negative acceleration. That is because his body is more elastic and can make a lot more room for a sudden excess of blood than his head can. Flyers have been known to experience forces up to +12G and still live but negative acceleration which results in forces greater than -3G is often fatal.



YOUR SENSE OF BALANCE

Do you know what gives you a sense of balance in flight? Part of it, of course, comes from seeing where you are in relation to ground and sky. Then, there is the feeling you have in your muscles and tendons when you turn or move up and down in the air. You've heard someone say, after descending rapidly in an elevator, "I think I left my stomach up there!" That person had no doubt he was moving downward, though he couldn't see it happen. By similar sensations while flying, pilots know just about how they are moving in relation to the ground. They call it flying by the seat of their pants. That's where they usually feel the pressure changes.





Equally important to your sense of balance, however, is the labyrinth or inner ear. This organ consists of 3 small circular tubes, called the semi-circular
canals, which are filled with a liquid. Whenever you
move your head, the liquid moves too. It then presses
against the walls of the tubes and causes the brain
to receive signals indicating your body is rotating in
a certain direction. If you whirl around in one direction and suddenly stop, you feel as if you were
revolving in the opposite direction. That's because
the fluid in those circular tubes of your inner ear is
still moving. For a moment or two, it gives your brain
a false impression. When such impulses are repeated
many times, as happens on a tossing ship or plane,
persons affected often become seasick or airsick.

HOW TO IMPROVE NIGHT VISION

Pilots must often fly at night. Naturally their vision isn't nearly as good then as it is in the daytime. But they are able to improve it considerably in several ways which you will find it fun to try yourself.

First, accustom your eyes to darkness by staying in a dark room or wearing red goggles for half an hour before going out into the night.

Once you're outdoors in the dark, don't look directly at the things you wish to see, but slightly to one side of them. You have a night blind spot at the center of your eye. The off-center parts of it are better able to see an object at night and detect its movements.

Eat foods, such as eggs, butter, carrots, spinach, and greens, which are rich in Vitamin A, essential to



good night vision. Pilots who fly in the dark do these things. In addition, they keep their planes as dimly lighted as possible at night. They read instruments, maps, and charts rapidly, or with one eye shut. Finally, they wear their oxygen masks from the ground up on night flights.

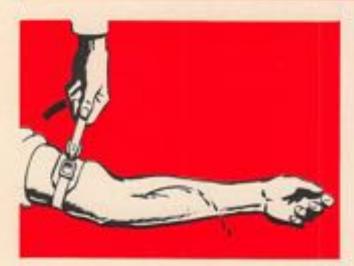


Every airplane should contain a first-aid kit. Every flyer should know the principles of first aid. Learn the Red Cross first-aid methods. If an accident occurs and someone is injured, be prepared.

The general objectives of first aid are to:

- L. Stop bleeding.
- 2. Sustain breathing.
- 3. Relieve pain.
- 4. Prevent shock.
- 5. Prevent infection.

Attend to the most serious problems first. If bleeding is occurring, stop it. If breathing has stopped, give artificial respiration. If bones are broken, splint them before you move the injured person.

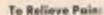


To Stop Bleeding:

- 1. Cover wound with a sterile dressing and apply
- 2. If this does not stop the bleeding, elevate the part.
- 3. If these measures fail, apply a tourniquet in the middle of the upper arm or middle of the thigh. You must release the tourniquet every 15 minutes for at least a few seconds, depending upon the amount of bleeding.

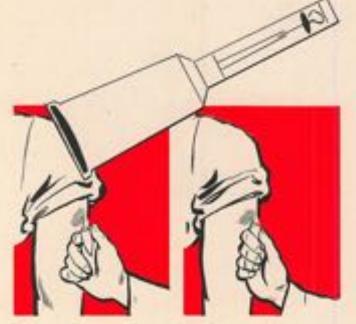
To Prevent Infection:

- 1. Apply coat of iodine to small cuts and scratches.
- Sprinkle sulfa powder into larger wounds.
- 3. Cover wound with sterile dressing.



If pain is severe, inject morphine if available.

- 1. First paint the skin with iodine.
- 2. Then thrust needle through the skin.
- 3. Slowly inject contents of the tube of morphine. Morphine relieves pain, decreases shock, and facilitates moving the injured. However, never give morphine to anyone who is unconscious, to a person with a head injury, or to one who is breathing less than 12 times a minute.



Frectures

- 1. Don't move a person with a broken hone unless absolutely necessary.
- 2. Splint the broken limb, using boards, poles, or rolled-up blankets or newspapers.
- 3. If the broken bone protrudes through the skin,









stop the bleeding sprinkle sulfa powder into the wound, and cover with a sterile dressing.

- 4. Inject morphine, if available.
- 5. Do not attempt to set the bone.

Burns

- Apply boric ointment, sulfa ointment, or other burn ointment to a sterile dressing.
- 2. Apply the dressing to the burn.
- 3. For severe burns give morphine, if available.
- 4. Don't open blisters.

Shock

Shock follows severe injuries, especially fractures and burns. The danger signs are pale and clammy skin, shallow breathing, and sometimes nausea and vomiting.

- 1. Stop the bleeding.
- Keep patient warm with blankets, but avoid excessive heat.
- Put patient on his back with head slightly lower than feet.
- 4. Give him pure oxygen to breathe, if available.
- 5. Inject morphine, if available.

Frauthite

- Fingers, toes, ears, cheeks, chin, and nose are most commonly affected.
- Numbness, stiffness and whitish discoloration are the first symptoms.
- Wrinkle your face. If it is numb, frostbite is beginning. Warm cold spots with your bare hands.
- If frostbite occurs, warm the affected part gradually against warm parts of your body such as your ampits.
- 5. Never warm a frostbitten part rapidly.
- 6. Do not rub a frostbitten part.
- 7. Keep it dry. Don't put it in water, kerosene or any other liquid.
- 8. Cover with a sterile dressing.
- 9. If blisters develop, do not open them.

WHAT PLANES ARE THESE?





Check your server on page 3-25



Unconsciousness or Near Unconsciousness

Oxygen lack, carbon monoxide poisoning, and injury to the head are important causes. If breathing has stopped, begin artificial respiration immediately:

- Lay the patient on his belly with one arm bent at elbow, face resting on hand and other arm extended over head.
- Open his mouth and remove all foreign substances such as false teeth and chewing gum.
- 3. Give him pure oxygen to breathe, if available.
- Kneel astride patient's thighs with your knees about even with his. Place palms of your hands against small of patient's back with your little finger over the lowest rib.
- With your arms stiff, swing your body forward slowly so that your weight is gradually applied over patient's back. This should take about 3 seconds.
- Release your hands with sudden snap and swing backward to remove all pressure from patient. After about 2 seconds repeat this operation. Continue for at least 2 hours or until normal breathing has begun.
- 7. Keep patient warm.
- Do not give morphine.

Dangerous Gases

Exhaust gases are poisonous. They contain carbon monoxide, which is perticularly hazardous, and the hazard increases at altitudes above ground level. Headaches, namea, shortness of breath, dizziness, dimming of vision, unconsciousness and even death may occur when it is breathed. Although carbon monoxide has no odor, you should suspect its presence whenever you smell exhaust gases in the airplane. If you detect exhaust gases or any other fames while in flight, you should protect yourself by wearing your oxygen mask and breathing pure oxygen.

WHAT PLANES ARE THESE?





Check poor oneseer on page 2-20

Transportation of Wounded

If it becomes necessary to move an injured person, improvise a litter with 2 poles and a pair of jackets. Turn the sleeves inside out and insert the poles through them. Then button jackets over the outside of the poles. You can obtain additional support by using boards or cardboard inside the jackets. You can also improvise litters with poles and blankets.



Physical Fitness AND REQUIREMENTS FOR FLYING



The physical requirements for flight training in the military air services are most demanding and stripgent. You will understand the reason if you look into the pilot's cabin of one of our heavy bombers and notice the hundred-odd instruments-controls, switches, levers, dials, and gages-that line the walls, ceiling, and floor. Then imagine you are dressed in a heavy flight suit, boots and mittens, or in electrically heated clothing, with a parachute strapped on your back. An oxygen mask with a built-in microphone covers your face. Your eyes peer through goggles, Your ears are trying to hear messages coming through the earphones amid the roar of four 1000 horsepower. engines. Imagine, moreover, that you are 6 or 7 miles above the ground, with the atmospheric pressure reduced by three-fourths and the outside temperature 60 to 70 degrees below zero. Only persons in the best possible physical condition can function efficiently. in such an environment.

Many persons are now being accepted for military service who would have been rejected previously because of physical defects. However, these men cannot receive advanced training, especially flight training, unless they can pass the rigorous physical examination required of all flyers. The Army's physical requirements for flying are rigidly prescribed. Unless you can meet them, you can't fly. A careful history is compiled of all the diseases, operations, and injuries which you have had. Certain ones of these are disqualifying. A Flight Surgeon, who is familiar with the physical requirements which flying imposes, then will give you a physical examination.

Your posture must be good. Physical training and regular exercise will help you attain this. Bad posture which is not correctible will disqualify you.

. Your body will be examined carefully from head to foot. The Flight Surgeon and his assistants will record your pulse and blood pressure and observe their response to exercise. Poor physical condition will show itself in this test. They will examine your eyes by a variety of tests because good vision, including color vision, is of extreme importance to all flyers. Your nose, ears, teeth, throat, heart, lungs, and abdomen will be examined with equal thoroughness. They will make an x-ray picture of your chast and test a sample of your blood in the laboratory. Only the most fit will be permitted to fly. Your nervous system and your psychologic reactions must stand up under exacting tests, for emotional stability is one of the primary requirements for efficient and safe flying.



In addition you must conform to certain standards of height and weight in order to fly in the Army Air Forces. Your height must not be less than 60 inches or more than 76, your weight not over 200 pounds. Here are the height and weight requirements for leading positions in the AAF:

EXAMINATION FOR			WEIGHT Min.	
Pliet, glider pliet, service pliet	64	76	104	200
Fighter pilot	64	12	114	100
United pilot	64	11	114	170
Bonberlier (8-36)	-	п	105	100
Flight norse	62	**	105	340
Aerial gionner	- 60	12	105	100

There are several conditions that affect the development and maintenance of a desirable level of physical fitness. We have already emphasized the importance of regular participation in a physical training program. Other factors that influence physical fitness favorably or adversely and are of particular significance to flyers are care of the eyes, care of the teeth, and nutrition.

Good eyesight is always an asset. When you are flying it is more than an asset. Keen, clear vision is indispensable. You can safeguard your vision in several ways:

- Protect your eyes from infection. Infection may be introduced from dirty fingers or dirty towels. Or it may come from an internal source, such as infected tonsils. Have a periodic medical examination.
- Eat an adequate diet. Good eyesight is dependent upon good nutrition. Vitamin A and riboflavin help protect your eyes from infection. Vitamin A is also important for night vision.
- Protect your eyes from injury. Wear protective goggles in laboratories when you are engaged in activities such as grinding, chipping, sandblasting, or pouring hot metals.

- Have a periodic eye examination by a physician.
 If minor troubles develop, the doctor will detect them early and help you correct them.
- Use your eyes properly. Use adequate lighting and proper posture while reading or working. These measures will help conserve your vision by preventing eyestrain.

Good teeth and good health go hand in hand. Good nutrition depends upon good teeth, for without them you cannot chew properly the foods you need. Moreover, good teeth depend upon good nutrition. The minerals you obtain from an adequate diet strengthen your teeth and help protect them from decay. Cavities and infections in and around your teeth may cause you to lose them. They may also cause trouble in other parts of the body. Take care of your teeth by eating an adequate diet, keeping your mouth clean, and by making periodic visits to your dentist.

What constitutes an adequate diet? Man is what he eats. An adequate diet is one which furnishes you with enough fuel to meet your body's energy requirements. It's one with the necessary amounts and variety of proteins, fats, carbohydrates, minerals, vitamins, and water to satisfy the body's needs for growth and repair. An adequate diet helps keep you at the peak of health. An inadequate diet impairs your efficiency and lowers your resistance.

It is important to eat 3 complete and varied meals a day. The common practice of skipping breakfast robs you of energy when you need it and makes it more difficult to satisfy your body's nutritional requirements. Soft drinks and candy cannot substitute for food. They provide you with temporary energy but contain none of the protective food essentials or vitamins. Get your vitamins in the food you eat. Vitamin pills are a poor substitute.

A good breakfast consists of fruit, cereal, eggs or meat, and bread, butter, and milk. Your lunch and dinner should contain a portion of fish, meat, cheese, eggs or fowl; one or more vegetables or fruits; a green or yellow leafy vegetable; and milk. These foods are basic. Add to them, if you like, with other dishes such as desserts and coffee, but don't neglect the fundamentals.



FLYING SAFETY

Flying is an exacting, serious business. It demands all your knowledge, attention, effort, judgment and skill. If you give it any less than your best it exacts a high price for your mistakes.

Relatively few sirplane accidents occur as a result of materiel failure; that is, failure of the engine or some other part of the plane. The vast majority of them result from pilot failure. Between 70 and 80 per cent of all accidents are attributable to one or more of the following faults on the part of the pilot;

Ignorance Carelessness Disobedience Bad Judgment Poor Physical Condition Half of all accidents happen during landing. Onethird are divided among take-off, forced landing, and tacting accidents, which occur with about equal frequency. The rest are the result of spins or stalls, collision with other aircraft, and collision with other objects such as buildings or mountains.

In about four-fifths of all accidents no one is hurt. Least dangerous are the taxing and landing accidents. Those caused by spins and stalls, on the other hand, although less frequent, are most dangerous.

Safety in flight depends upon you. There are standard practices, rules and regulations, which help defeat these enemies of safety. They only point the way. Flying is as safe or as dangerous as you make it.



The shoulder harness helps protect you in case of a crash or rough landing. It consists of 2 straps which attach to the back of the seat, come over the shoulders, and fasten to the buckle of the safety belt in front. Unlocked, it permits freedom of movement; locked, it prevents the wearer from being thrown forward on erash impact. The plane's abrupt contact with the ground tends to throw the upper part of your body against the instrument panel or windshold. By holding you securely against the back of the seat the shoulder harness helps protect your head, neck, shoulders and chest from injury. Experienced pilots say the routine wearing of the shoulder harness has prevented serious injuries and saved many lives.

Shoulder Horness





PET PROPER

The parachute is one of the best forms of life insurance. Never go up in the air with one without inspecting it. Remember, you may have to jump with it! Make sore the ripcord pins are not best and that the seal is not broken. See that the corners of the pack are neatly stowed, that the 6 or 8 opening elastics are tight.

Be sure that it fits properly. Handle it carefully, keeping it clean, dry, and away from oil and acid. Never fly without it, for you can't tell when unexpected trouble will develop in the air. Plan in advance for possible emergencies and decide how you will act in each. It is usually better to make an





RIGHT



WRONG



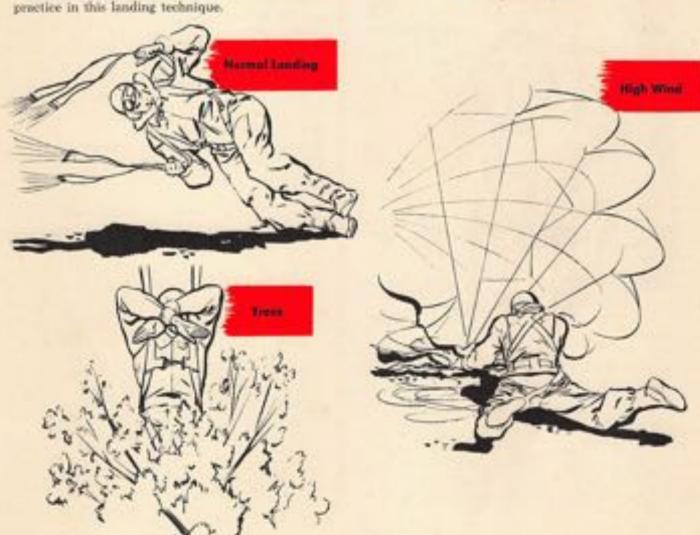
RIGHT

emergency landing than to bail out, if you have the airplane under control and if you can find a favorable place to land. If fire occurs during flight or if some other emergency forces you to bail out, follow this procedure:

- 1. Slow the airplane as much as possible.
- 2. Release safety belt and shoulder harness.
- 3. Open the canopy.
- Dive out and down, head first, keeping feet together.
- 5. Wait 5 to 10 seconds, then pull the ripcord.
- Turn your body to face in the direction of drift.Learn how to do this by manipulating the risers.
- Prepare for landing by placing your feet together and slightly bending your knees so that you will land on the balls of your feet.
- 8. Just before impact pull sharply down on the risers.
- 9. At the moment of impact fall forward or sideward into a tumbling roll to take up the shock. The Roll and Fall exercise in Section 4 provides excellent practice in this landing technique.



Clearing the Airplane



Emergency Equipment

A wise pilot makes certain he is prepared for emergencies before he takes off on any flight. A few simple items may make a great deal of difference. In addition, the AAF has designed kits of special value to flyers forced to land in desert, jungle, Arctic regions, or in the ocean. You will find how important certain items are if you need them and don't have them. These are essential:



WHAT PLANES ARE THESE?





Check your enterer on page 3-20



- 1. Fire extinguisher.
- 2. Smell hand ax.
- 3. Matches in waterproof container.



4. First-aid kit.



5. Compass.



6. Pocket-knife.



7. Gloves.



8. Centeen of drinking water.



9. Emergency rations.



10. Mosquito netting (in summer).



11. Sleeping bog (in winter).



GROUND WORK

There is a great deal more to flying than sitting at the controls of an airplane. And the pilot who is thoroughly familiar with ground operations is able to handle his ship more intelligently in an emergency or in combat. * For every plane in the air there must be a crew on the ground to supply it with fuel and oil, inspect it regularly, and keep it in good mechanical condition. It needs suitable fields on which to land and take off. Those fields must be selected with experienced care and a special knowledge of the requirements. They must be laid out and built to provide the greatest efficiency and safety, the best available facilities. Many persons of widely varied skills and training are needed to operate the cirfields after they are built, though their duties are similar whether they are at small civilian fields, large municipal ones, or Army air bases. Aids of many kinds to guide and inform the approaching flyer must be available and kept in order. In the event of accident, there must be fire-fighting equipment at hand and crash crews who know how to operate it speedily and well. * This section of your manual provides you with a valuable insight into the many and important details of selecting, building, and operating an airfield.

IN THIS SECTION ...

Airfields

Descriptions of Class I, II, III, and IV Airfields—Points to Consider in Selecting an Airfield Site—How to Lay Out Runways—Various Surfacings Used to Make Runways and Taxi Stripe—Runway Lengths, Grades, Markings—How to Lay Out Taxi Strips

Airfield Aids to Airmen

Wind Direction Markets—How Obstructions Are Painted—Airfield Lights: Rotating Beacon; Boundary; Obstruction; Runway; Wind Tee and Wind Cone Lights; Floodlights and Others

Hangars

Airfield Personnel

Distins of Operations Officer or Airport Manager—His Staff—Dispatcher's Duties—What the Weather Officer Dees—The Tower and its Operator—Duties of Recorder—Light Gun Signals—Traffic Patterns—Duties of Engineering Officer—Persons Supervised by Engineering Officer:Technical Impector; Line Chief; Flight Chief; Crew Chief; Hangar Chief; the Crew—10 Commandments Which Airfield Visitors or Servicemen Must Obey—How to Park Aircraft—How to Tie Them Down—Taxi Signals

Airplane Inspections

Preflight Inspection—Daily Inspection—Afterflight Inspection—25-Hour, 50-Hour, and 100-Hour Inspections—Engine Change Inspection—25-Hour After Engine Change Inspection—Daily Flight Inspection for Small Airplane—How to Check Propeller; Engine; Landing Gear; Wings; Tail Control Surfaces; Fuselage—Warm-Up—How to Refuel and Clean Aircraft—How to Service Airfield Facilities

Forms

CAA Form for Service and Overhaul.—Army Form 1 (Pllat Fills Out) and Form 1A (Crew Chief Fills Out).—Form 60A (for Airplane), Form 60B (for Engine), and Form 61 (for Propeller).—Form 418.— The Red Tag.—What Pilot Must Check Before Taking Off

Crash Procedures

Members of Crash Crew—What Crash Truck Contains—What a Crash Crew Member Should Know About His Airfield and Surrounding Countryside; Approaching a Crashed Plane; Locating the Parts of a Plane; Getting into a Crashed Plane

Fire Fighting

Types of Equipment—Important Points to Remember When Fighting on Airplane Fire... What to Do When Removing Damaged Aircraft

ARFIELLS

The Civil Aeronautics Administration divides airfields into 4 classes:

CLASS I AIRFIELDS

- Can accommodate small aircraft, usually privately owned.
- Have one or more landing strips between 1,800 and 2,500 feet long, at least 300 feet wide.
- May or may not have a small administration building and a small hangar.
- Should have 1 wind direction indicator and a fence to enclose the airfield property. If there is to be night flying, they should have an airfield beacon and boundary, obstruction, and runway lights.

CLASS II AIRFIELDS

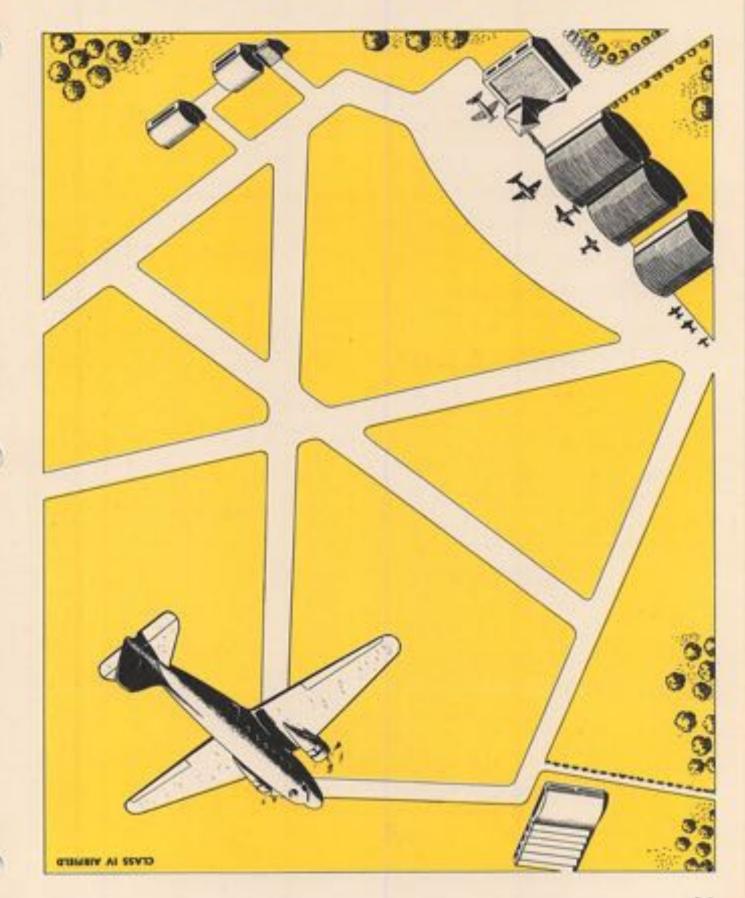
- Can accommodate aircraft of moderate size.
- 2. Have runways between 2,500 and 3,500 feet long, 500 feet wide.
- Have 2 or more hangers if there are large numbers of aircraft at the airfield.
- Maintain aids to aviation such as weather information, shop work facilities, and additional lighting facilities for night flying.

CLASS III AIRFIELDS

- Are found at intermediate points on main line sirways and on smaller "feeder line" airways systems.
- 2. Can accommodate large transport planes.
- Have several paved runways, 2,500 to 4,500 feet long.
- Have an air traffic tower equipped with 2-way radio and light gun signals, landing area floodlighting, instrument approach system, and special instruments for determining weather.

CLASS IV AIRFIELDS

- Are found at large cities and at junction points along the airways systems.
- Can accommodate twin and 4-engine aircraft.
- Have several runways, 4,500 feet long and over.
- 4. Maintain large hangars to house and repair aircraft.
- Have administration building with offices for airline companies, Airways Traffic Centrol, and other agencies.
- Have passenger facilities such as restaurants and automobile parking lots.
- Usually have a separate set of buildings and hangara for Army aircraft.



In selecting an airfield site, here are the points to consider:

1. Area Needed

A small airfield should contain between 150 and 200 acres. Nearby areas, without obstructions, should be available in case air traffic grows and you wish to expand the airfield at a later date.

2: Transportation

It must be easy to go to and from an airfield by automobile, bus, and other means.

3. Obstructions

These are objects that block the approach zones of an airfield. There are natural obstructions like hills and trees, or man-made obstructions such as buildings, telegraph poles and wires, smoke stacks, and water towers.

Note: An approach zone starts at the boundary of an airfield and continues 2 miles beyond each landing strip. At the strip it is 500 feet wide; 2 miles out it is 2,500 feet wide.

Approach zones must be clear of all objects which would obstruct an airplane coming into the airfield at a 20-to-1 glide—that is, 20 feet forward to every 1 foot of descent—from a point 2 miles out. For Class II, III, and IV airfields, this glide ratio is 30 to 1, or 30 feet forward to every 1 foot of descent.

4. Terrain and Soil

An airfield must drain quickly after a rain. Choose:

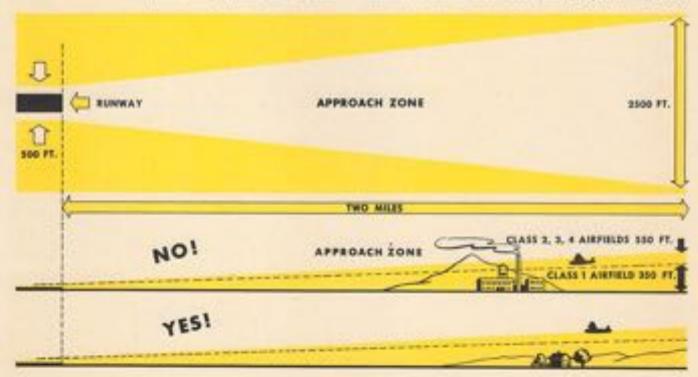
 a. An area not so flat water cannot run off it easily.
 b. An area high enough in reference to the rest of the terrain to drain naturally.

Gravel and sandy soils absorb water like sponges. Therefore, it can be trapped and drained from underneath. Clay soils repel water. Accordingly, airfields built on clay must be graded so that water will drain from the top.

If you select an airfield site with good terrain and soil conditions, you will save the cost of expensive drainage systems.

5. Winds

Runways are laid out according to prevailing wind



directions, determined from local weather history.

6. Distance From Other Airfields

The center of one airfield should not be closer than 6 miles to the center of another. This is a matter of safety. Otherwise, traffic of one airfield interferes with traffic of the other.

7. Other fectors:

- a. Proximity of electric power, telephone, gas, water, and sower lines.
- h. Availability of construction materials such as good gravel and sand.
- Prevalence of ground fogs, or smoke blown into the vicinity of the airfield.

WHICH OF THESE AIRFIELDS WOULD YOU RECOMMEND?



RUNWAYS AND TAXI STRIPS



Where land slopes too abruptly in the center of a field, build L-shaped runways around the slope.

Where land slopes at both ends of a field, build T-shaped runways.

When airfields are expanded to include more runways, slopes or declivities must be filled in. It is better, of course, to find an airfield site you can expand without the need of extensive construction work.

Runways and landing area should not have a grade of more than 1½ per cent. Steep grades are hard to judge when landing, especially at night.

Water should drain off the runways immediately and away from buildings and hangars,

Renway Surfaces

Dirt runways are muddy and slushy in winter time, dusty in summer. They become bumpy and rutted. Taxiing aircraft throw pebbles and small stones into the propellers, causing nicks and holes.

Small airfields use grass runways and landing areas successfully where there is not heavy traffic at the field and where grass is kept up well, especially during rainy months.

Class I sirfields do not need paved runways or paved taxi strips, but where it is possible, build them. They are:

- 1. Easy to keep free of water and snow
- 2. Easy on the plane and its landing gear
- 3. Easy on propellers.

Here are various types of surfacing used in runways and taxi strips:

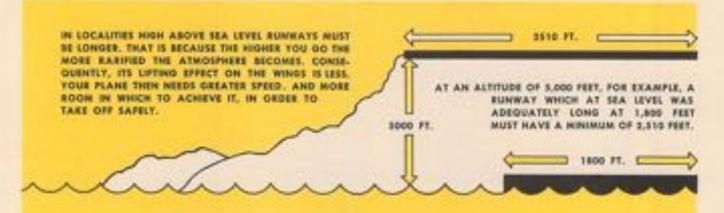
1. Sand elay

- 2. Gravel
- 3. Oyster shell
- 4. Bituminous soil stabilization
- 5. Cement soil stabilization
- 6. Macadam
- 7. Sand asphalt
- 8. Lime rock
- 9. Concrete
- 10. Asphaltic concrete
- 11. Bituminous surface treatments, and others.

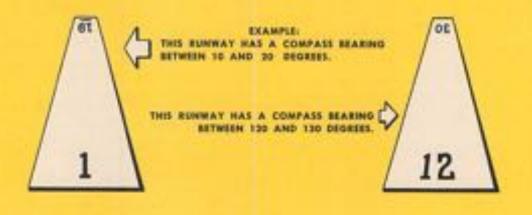
Taxi Strips

Taxi strips should lead easily and naturally from hangurs to the ends of the runways. Lay them out in such a way that taxiing aircraft will not interfere with incoming and outgoing traffic or with other planes taxiing on and off the field. Where possible, pave them.

IMPORTANT FACTS TO KNOW ABOUT RUNWAYS

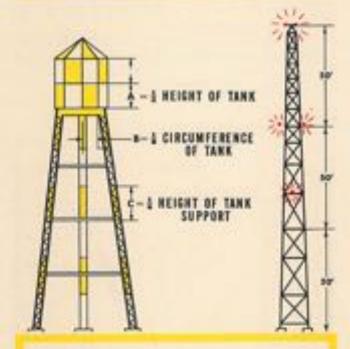


BUNWAYS ARE MARKED MEAR THEIR ROUNDARIES WITH HUMBERS VISIBLE FROM THE AIR. THESE NUMBERS HAVE A SPECIAL MEANING, THEY INDICATE THE COMPASS BEARING OF THE RUNWAY, MINUS ITS LAST DIGIT.



AIRFIELD AIDS TO AIRMEN





Marking of Obstructions

Obstructions are painted throughout their height with alternate bands of international orange and white, chrome yellow and black, or chrome yellow and white. At night they are marked with red lights.

Lights

Where there is night flying at a field there must be certain lights to guide pilots or to warn them of obstructions. These lights are kept burning from half an hour after sunset to half an hour before sanrise and at all times when visibility is poor.

- Airfield Rotating Beacon. This is a 36-inch rotating beacon, capable of giving light from 2 sides. It is usually mounted on the airfield administration building or on a beacon tower where it can be seen from all sides.
- Boundary Lights. The airfield boundary is marked with white lights.
- Obstruction Lights. Obstructions are marked with red lights. Flashing red beacons are placed at the top of very high objects while smaller red lights, set up at 50-foot intervals, clearly show the outlines of the obstruction.
- Runway Lights. Runways are outlined by 2 parallel rows of lights. The lights across the landing strip at the approach end of each runway are green.
- Wind Tee and Wind Cone Lights. Wind tees have green lights which can be seen from the air. Wind cones, too, are lighted by reflectors in such a manner that pilots overhead can see them. In the center of the wind cone lighting assembly is an obstruction light.
- Floodlights. At larger airfields, floodlights illuminate landing areas and hangar aprens. They must throw a uniform light without shadow. From the air, shadows look like hollows in the ground. The lights must not glare or they will blind pilots momentarily.
- Other Lights. Auxiliary range lights, approach lights, and taxi guidance lights assist a pilot in finding a field or in taxiing, once he is on it, but they are not found at all fields.

Another aid to the pilot is the airport code beacon found at large fields. This beacon flashes a green light in code so that the pilot can tell which airfield he is approaching or passing over. Large airfields have a call letter designation. These letters are marked on airways maps.

Airfields which have standard lighting facilities are marked "LF" on airways maps.



The Large Hangar

Used at Class III and Class IV airfields, the large hangar;

Provides space for large numbers of small aircraft, several large aircraft.

Houses such equipment as crames, pulleys, ladders, and other devices used in servicing aircraft.

Allows ground crews to work in freedom and safety.

But it is costly and difficult to build.

The Smoller Hangar

This is usually found at Class I and Class II airfields although larger airfields sometimes prefer several small hangars to one or two big ones.

It can house several small planes. It also can be built at a reasonable cost, for it needs no expensive foundations, trusses, or large doors.

Several small hangars are less of a fire hazard than one or two big hangars.

You can stack small aircraft in hangars of moderate size in such a manner that 100 or more are housed in one building. Stacking consists of tilting them on their noses with the fuselages at an angle of about 80 degrees with the hangar floor. You must exercise care in doing this, however, so that propellers, engines, and bracings are not damaged.



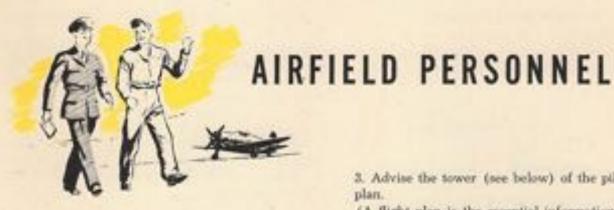
T-type Hungar

At small fields the T-type hangar is most practical. It is a series of individual garages for small aircraft. Each garage dovetails into the next. T-type hangars can be extended indefinitely as more aircraft need housing facilities. Since they are built to fit aircraft contours, you must back the aircraft into them. (See illustration)

Advantages:

- 1. Each airplane is housed individually.
- Equipment and personal possessions can be kept in the hangar space.
- 3. The pilot renting the space can lock his garage when his plane is housed there or while he is flying.





Operations Officer or Airfield Manager

One person is in charge of an airfield. At an Army hase he is called the Operations Officer; at civilian airfields he is called the Airport Manager or Superintendent. He is responsible for:

- Proper clearance of aircraft.
- 2. Issuing orders pertaining to local flying and the functioning of the airfield.
- 3. Correct servicing and maintenance of aircraft based at the airfield or stopping there.
- 4. Safety and discipline at the airfield.

At any time, within his discretion, he may close the field for flying or forbid any plane or pilot to leave the ground.

His office is in the operations or administration building of the airfield. At Army bases it is called the operations office.

Office Stoff

The person in charge of an airfield has a staff of people, including one or more assistants, to help him take care of operational functions."

This staff:

- 1. Acts in his place when he is absent.
- Keeps track of various forms used in flying.
- Takes care of correspondence.
- 4. Maintains files.
- Helps prepare reports.

The Dispatcher

At the dispatch desk a pilot gets all information about his intended flight and fills out his clearance form. In charge of this desk is a Dispatcher. He usually has one or more assistants.

The Dispatcher's duties are to:

- 1. Help each pilot fill out his clearance form cor-
- 2. Present this form to the Operations Officer for check and approval.

- 3. Advise the tower (see below) of the pilot's flight plan.
- (A flight plan is the essential information of an intended flight.)
- 4. Transmit the flight plan to Airways Traffic Control when a pilot flies beyond the local area.
- Keep a file of pilots' clearances.
- 6. Keep an index of Notices to Airmen up to date.
- 7. Have available the latest regional and sectional maps, radio facility charts and periodicals of interest to pilots.
- 8. Keep a departure and arrival board, usually a blackboard that lists the departure and arrival times of all aircraft coming into and going out of the local flying area.

The Weather Officer

At the weather office a pilot gets all information about weather conditions both at the airfield and in other areas. In charge of this office is a Weather Officer or weather expert. He has a staff of people who are familiar with meteorology.

The Weather Officer:

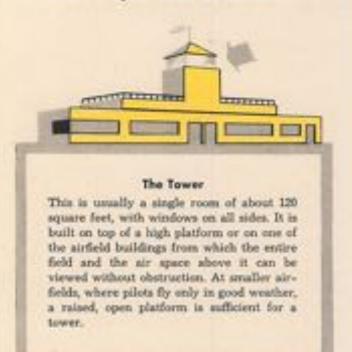
- 1. Advises the pilot of weather conditions along his proposed route and at his destination.
- 2. If weather conditions are favorable, enters all weather information along the proposed route on the pilot's clearance form.
- 3. Maintains a detailed weather map that shows general weather conditions throughout the country.
- 4. Keeps a file of weather sequences received from weather reporting stations.
- 5. Maintains a chart showing winds at different altitudes. This is called a Winds Aloft Chart.

The Weather Officer receives his information from:

- 1. The United States Weather Bureau at 6-hour intervals. This information is put down on the weather
- Teletype weather sequences obtained hourly from weather reporting stations.
- 3. Pilots who have just landed.

Air Traffic Tower Personnel

Air traffic on a field is directed from the air traffic tower. Responsible for the operation of the tower are the Tower Operator and the Recorder.



The Tower Operator

- Directs all air traffic flying in the local area of the airfield and all pilots taxing on the ground.
- Advises by radio or light gun signal whether it is safe to land or take off, what runways to use, and what taxi strips to use.
- Gives information such as altitude of airport, altimeter setting, wind direction and time.

- Helps pilots with radio check, and answers questions if they pertain to the flight.
- Looks out for the safety of aircraft on the field by carefully supervising traffic.
- Stops all aircraft movement on the field and prevents all planes from landing when an accident occurs or when a distressed airplane makes an emergency landing.

When a pilot is within 3 miles of a field he must follow all tower instructions, unless he first advises the tower operator of his intentions and obtains approval of them.

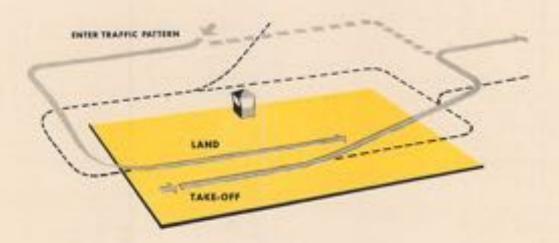
The Tower Recorder

- Keeps a continuous record of all planes arriving and departing from the field.
- Informs Airways Traffic Control of departure times of aircraft flying beyond the local area.
- Receives from Airways Traffic Control the arrival times of aircraft flying into the area.
- 4. Assists the Tower Operator wherever possible.

Troffic Potterns

When a pilot is in sight of an airfield he advises the tower by radio of his approach. At that time he may be given landing instructions. If not, he circles the field, always to the left unless otherwise instructed, until he is told on which runway to land. In landing, he follows the traffic pattern illustrated below:

If an airplane is not equipped with radio its pilot circles to the left, as above, until he receives a green light signal from the tower. To acknowledge this signal he rocks his wings or dips the nose of his airplane. If he receives no signal he circles, finds the direction of the wind by looking at the airfield wind indicator, and lands on the appropriate runway.

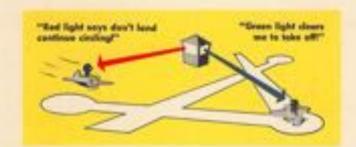




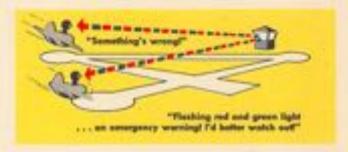
Light Gun Signals

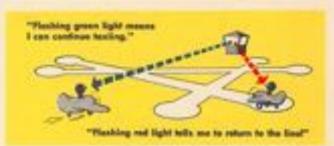
Aircraft not equipped with radio must be directed from the tower by light gun signals. A light gun is a round, open cylinder about 1½ feet long, with a reflector at one end. When the Tower Operator points the open end of the light gun at an airplane, the pilot sees either a red or green light.

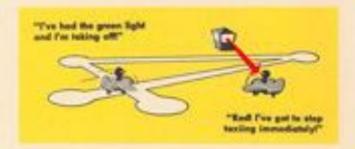
In the daytime, the pilot acknowledges these signals by moving the allerons or rudder of his plane. At night he can signal the tower with his landing lights.













Landing lights on show desire to lund



Use one flock of lending lights to extraordedge signeds from ground



Minking lending lights means: Turn off flood lights' . . . if on. Turn on flood lights' . . . if all.



The Engineering Officer

At Army airfields there is an Engineering Officer, at civilian fields the Airport Manager usually takes care of engineering duties.

The Engineering Officer is responsible for:

- 1. Maintenance of all hangars and machine shops.
- Maintenance of the airfield, including runways and lights.
- 3. Inspection and overhaul of aircraft.
- 4. Duty assignments of maintenance crews.
- Proper keeping of forms used in the servicing and overhaul of aircraft.

Here are 10 commandments

you must always observe at an airfield:

- Do not go on the landing area unless you are authorized to go there or are conducted there by a flyer or airfield attendant.
- Do not drive an automobile on the landing area without permission.
- Never smoke on the apron or within 50 feet of any simplane.
- Do not start or warm up on sirpliene when hangars, shops, other buildings, or persons are in the path of the propeller stream.
- Do not start or warm up an airplane when it faces another zirplane.
- 6. When you service alteraft with fuel, pround all tanks to discharge static electricity.
- Do not fuel an airplane while the engine is running.
- When an airpiane is started or fueled, make sure an aircedant stands by with a fire extinguisher.
- B. Do not move a peopeller unnecessarily and at all times stand away from it. A peopeller is as dangerous as a buzz-saw.
- 10. When you are belging to move an aleplane, do not take hold of the middle of strafa or braces, rudder, or other weak places. The strong places are at the ends of the braces and along the fuselege. Weak places generally are marked on an airplane.

Under the supervision of the Engineering Officer are: Technical Inspector: Who inspects aircraft to make sure they are airworthy.

He sees that periodic inspections are made.

Line Chief: Who supervises maintenance of aircraft at a field or tactical unit.

He sees that all forms are filled out.

Flight Chief: Who supervises maintenance crews working on a single flight.

He checks aircraft before they are returned to service.

Crew Chief: Who is the lead mechanic for the inspection, maintenance and servicing of one or more airplanes. He fills out all maintenance forms.

Hangar Chief: Who is in charge of the upkeep of hangars and their tools and equipment.

The Crew: Who are mechanics and helpers assigned to a crew chief. They inspect, service, clean and repair aircraft.

Duties of Servicemen

When you are on an airfield, either as an observer or as a serviceman, you must be careful at all times. Your life, the lives of servicemen and pilots, the condition of aircraft and equipment, depend upon what you do and how you do it.

Parking Aircraft

Park aircraft far enough apart so there is no danger of collision when they are moved. Set brakes or place chocks under the wheels. It is good practice to use both brakes and chocks. Aircraft must be parked only in areas designated by the Operations Officer or Airport Manager.

If there is more than a 20-mile wind, tie down aircraft, especially light aircraft, which are not in the hangars.

This is how you tie down an airplane:

- Drive a stake into the ground in front, beyond the end of each wing, and behind the tail.
- Attach a rope from each stake to a strong point on the plane. Do not tie ropes too tightly as moisture may cause them to shrink,
- 3. Lock control surfaces by inserting wooden clamps to hold them in neutral. Lash the control stick or wheel and rudder. If you use a clamp, attach a rope from the clamp to the door to remind the pilot to remove the clamps before takeoff.
- 4. Cover aircraft whenever possible.

Taxi Signals

When a pilot taxies a plane near buildings or parked aircraft, an assistant must stand by to help him. Use these standard hand taxi signals:

HAND SIGNALS FOR TAXIING

THESE SIGNALS, PRESCRIPED BY AAF REGULATION 42-10. DATED 2 AUGUST 1941, REPLACE ALL FORMER TAXI SIGNALS. THEY WILL BE USED BY CREWS OF AAP, USH, USMC, RAP, ECAF, AND EN.



A FLAGMAN with checkered flag will meet siecraft on any landing space where the nature of traffic demands it. He will direct the pilot toward the taxi signelmen who will stand with both arms extended full length above his head.





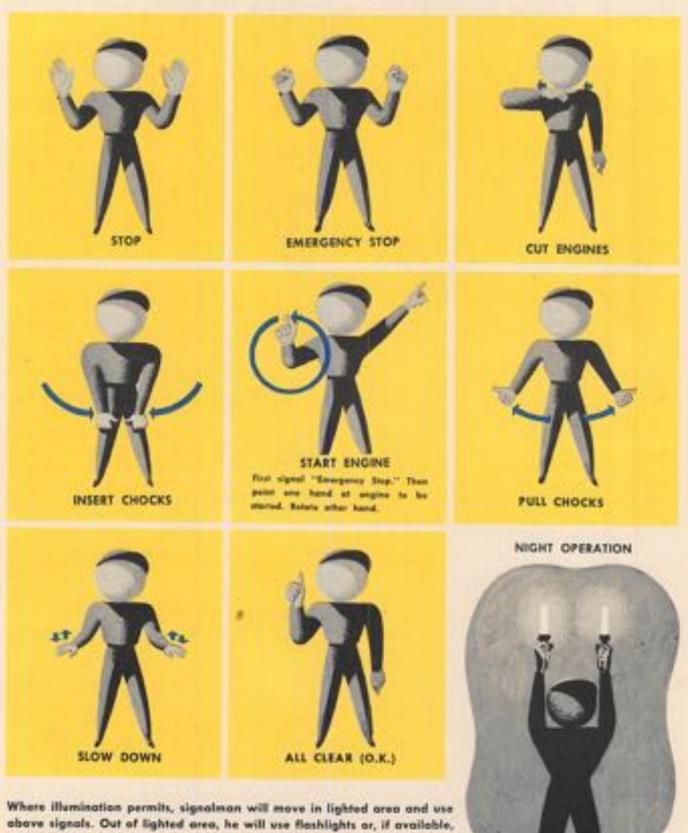
Te signal turns, signalmen will becken "Come Ahead" with hand on the same side as the wing to be brought breund, and paint with other hand at wheel to be braked.



THE SIGNALMAN will direct taxling from a position forward of the left wing tip of the airplane, where the pilet can see him easily all the time.



TOWING. Left wing tip signalman gives all signals to tractor driver.



Where illumination permits, signalman will move in lighted area and use above signals. Out of lighted area, he will use fleshlights or, if available, Lucite wands. All signals same as above except "Emergency Stop," which will be given by crossing lights in front of face.



Every airplane must be inspected at certain intervals. All inspections which the Army Air Forces require are outlined here. The Civil Aeronautica Administration requires similar ones. (For details, see War Department Technical Manual 1-415, Airplane Inspection Guide.)

Preflight Inspection

This is made the first thing in the morning, before an airplane is flown. It consists of a visual check of controls, fuel system, and engine intruments, all cowlings (coverings), fuel and oil caps.

Daily Inspection

This is a detailed, visual inspection given to every airplane each day, unless the plane is in storage or undergoing repairs.

Afterflight Inspection

Made after each flight, this is a check of the airplane's general condition and includes correction of any mechanical difficulty.

25-hour Inspection

This inspection of an airplane is made every 20 to 30 flying hours. It includes a check of wear and tear and reveals any deterioration at an early stage.

No airplane can remain more than I month without a 25-hour inspection, regardless of flying time, unless it is in storage or undergoing overhaul.

This is made between the 40th and 60th flying hours of the airplane, and every 40 to 60 flying hours thereafter. All parts are inspected to see if they are in good condition and working properly and to make sure that the prescribed maintenance has been done.

50-hour Inspection

100-hour Inspection

This is made during every second 50-hour inspection and consists of maintenance operations in addition to those which the 50-hour inspection requires.

Engine Change Inspection

Airplane engines must be removed for overhaul after from 1,000 to 5,000 fiying hours, depending upon the make of the engine. Specifications for this overhaul come with the airplane.

25-hour After Engine Change

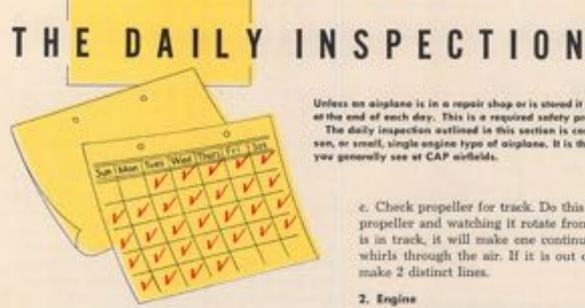
This is a thorough inspection which is made between 20 and 30 flying hours after the engine change.

Special Inspections

At specified intervals prescribed inspections and operations must be made.

Warnings

When an airplane is undergoing repairs or has some part missing, the evew chief places a red tag on the control column or some prominent place inside the cockpit where the pilot will be sure to see it. This card tells what repairs are being undertaken or what part is missing.



The daily flight inspection detailed here follows the Civil Aeronautics Administration's Daily Flight Inspection Record. Army servicemen follow the points outlined in the War Department's Technical Manual TM 1-415, Airplane Inspection Guide, You can use either in making a daily inspection of any airplane.

1. The Propeller

- a. Inspect propeller blades for pits, cracks, and nicks. Run your hand over the edges of the propeller to find cracks and nicks. Gravel thrown up from the wheels often causes propeller damage.
- b. Inspect hubs and attaching parts for defects, tightmess.

Warning

Make sure that the awitch is "OFF" when you touch the propeller. But do not trust it even then, for a broken wire has the same effect as turning the switch "ON." Reason: the ignition arrangements of an airplane are based on the disconnect system.

Unface an airplane is in a repair shop or is stored it must be inspected at the end of each day. This is a required safety precoution.

The daily inspection autlined in this section is confined to the linisen, or small, single engine type of girplane. It is the kind of abulane you generally see at CAP airfields.

> e. Check propeller for track. Do this by starting the propeller and watching it rotate from one side. If it is in track, it will make one continuous circle as it whirls through the air. If it is out of track, it will make 2 distinct lines.

2. Engine

- a. Inspect engine cowling for cracks and security. The cowling is the hood or cover that goes over an engine.
- b. Remove cowling and inspect engine to see if there are any cracks in the motor mount. By pushing gently against the motor, you can discover cracks. Check exhaust stacks and collector ring for cracks and security. Old exhaust stacks develop cracks and holes.
- c. Have man in cockpit move carbureter heat "ON" and "OFF." Put your finger up the vent to see if the valve works. Lubricate if necessary.
- d. Check spark plug terminal assemblies for cleanliness and tightness.
- e. Inspect ignition wiring and harness for security of mounting
- f. Clean main fuel-line strainers. Check sediment. bowl and hose leading to bowl. In winter, check to see if there is ice in the hose.
- g. Drain small quantity of fuel from bottom drain and inspect it.
- h. Check fuel and oil systems for leaks, vent openings, surplus oil.
- i. Check fuel and oil supply. You can check the oil just as you do in an automobile.
- j. Check all bolts and nuts on engine and mount. See that cotter keys are on bolts and that safety wire in secure.
- k. Turn propeller; check compression of cylinders.
- 1. Check throttle to see if all connections are secure.

3. Landing Goor

- a. Inspect tires for defects and proper inflation.
- Inspect wheels for cracks and distortion and hub caps for security.
- c. Inspect shock-absorber units. If the shock absorber has a shock cord, inspect to see if it has deteriorated.
- d. Inspect strut-retaining bolts and fittings for security.
- e. Inspect brace wires for tension and security.

4. Wings

- a. Inspect wing covering for damage, buckled ribs, and end bows. Check the wings both top and bottom. In flight, an airplane is lifted mostly from the top of the wings and therefore this is their most important surface. Test fabric by tapping. If it resists your tapping it is in good condition. If it is rotten it will give way. Check wings by sighting along the top surface from the wingtips.
- b. Inspect attachment fittings for security.
- e. Check struts for security of terminal connections. You can do this by close visual inspection and by gently rocking the wings and watching to see how firm the braces are.
- d. Check allerons and alleron hinges and controls. By looking at them carefully and by moving the allerons gently, you can tell if they are in good order and working properly.

5. Tail Control Surfaces

- a. Inspect covering for damage, buckled ribs, and hruised edges. Be sure to look underneath the tail surfaces as well as above.
- b. Inspect attachment fittings for security.
- c. Check struts and brace wires, especially the terminal connections. Check above and below.
- d. Check control surface hinges. See if they work easily. See if there is much play in them. Check cotter keys.

- Inspect control cable, pulleys. Lubricate if necessary.
- f. Check stabilizer adjustment.
- g. Check tail wheel assembly. If it is damaged it might be pushed up against the rudder. Lubricate if necessary.

6. Fuselage

- a. Inspect covering for damage and distortion. Get down on your hands and knees and look underneath the fuselage.
- Inspect control column assembly (stick) for freedom of movement, security of attachments.
- c. Inspect rudder pedal assembly and control system (cables and pulleys) for freedom of movement and security.
- d. Check fire extinguisher and first aid kit. See that the fire extinguisher is full of fluid. You can find this out by shaking it.
- e. Check proper functioning of lighting system.
- f. Inspect safety belts.
- g. Clean all windows.

7. Warm-up

Note: Before an airplane is flown it should be preflighted. That is, the engine is warmed up until it reaches takeoff temperature. While it is being warmed, check the instruments. Preflight also includes visual inspection outlined in this section.

- a. Make sure that checks are under wheels.
- b. Warm up and check engine operation.
- c. Test magnetos and all tanks.
- d. Check engine controls.
- e. Check position of earbureter air preheater.
- f. Check operation of carburetor mixture control.
- g. Check radio equipment.
- h. Check: Oil temperature, oil pressure, rpm, amount of fuel, amount of oil.
- i. Check idling rpm.

CAP Cadets must not do this unless they have had previous experience, or have been given special instruction.

Cleaning Aircraft

Clean aircraft regularly to preserve the surfaces and to improve their appearance. While you are cleaning an airplane you can check breaks in ribs, deformations in metal structures, tears in fabric, excess play in fittings or controls.

Refueling the Airplane

When you refill an airplane with fuel or oil, be careful to:

- 1. Walk, stand, and sit in the right place. Aircraft are designed to take concentrated loads in only a few places. Learn where those places are.
- 2. Fill fuel and oil tanks only to rated capacity.
- 3. Use the proper grade of fuel, or there can be serious damage. (L 2 M planes use 73 octane gasoline only, or the next higher grade in emergency.)
- 4. Ground (electrically) the tanks before filling them with gasoline.
- 5. Replace tank caps securely.
- 6. Find out the amount of fuel in a tank always by measuring with a clean stick. Gages can be wrong.

Servicing Airfield Facilities

Hangars, fuel pumps and other airport facilities must be serviced as well as aircraft. A good serviceman:

- 1. Keeps the hangar in orderly condition.
- 2. Maintains grounds. This includes repairing fences. clearing away rubbish, and similar work.
- 3. Knows how to operate and care for equipment such as fuel trucks, pits or pumps, oil pumps, tractors, and other machinery.
- 4. Helps maintain the landing area. This work includes mowing grass, removing snow, repairing soft. or rough spots, and examining hard-surfaced runways, taxi strips and aprons for nails or other tiredestroying objects.
- 5. Replaces worn out airport lights:
- 6. Knows how to do ordinary jobs such as changing tires, cleaning and adjusting spark plugs, and cleaning strainers.
- 7. Knows fire prevention methods, where the fire extinguishers are, and how to use them.
- 8. Knows first aid.



Do <u>not</u> leave airplanes standing near a gasoline tank or truck!

THIS IS A DANGEROUS PRACTICE!

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PLIGHT REPORT - PROPERTY		-

OWING

Each airplane carries a set of forms, These forms tell the complete story of each flight: who the pilot and passengers were, where they flew, the amount of fuel the plane used, and what servicing was done.

CAP airfields generally use the Civil Aeronautics Administration's forms for the service and overhaul of aircraft. The Aircraft and Engine Logbooks, the Periodic Aircraft Inspection Report, and other forms are available at all civil airfields. If Army aircraft are used, Forms 1 and 1A must be kept. Army forms are listed below:

Form I

The pilot fills out this form. Before takeoff he writes in as much of the data as he can. For instance: his name, name of passenger or passengers, station, duty, destination. Upon landing and before leaving the cockpit, he fills in the time entries.

What a Pilot Must Check

Before takeoff, a pilot must check to see if the airplane is properly serviced. He must also check certain instruments in it. Here is a check list used in the liaison type of airplane:

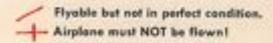
- 1. Check flying controls for free movement.
- 2. Check gas, oil, and "S" on Form 1A.
- 3. See that gas valve is "ON."
- 4. Check operation of both magnetos. Minimum static rpm 2,050.
- 5. Check to see that engine instruments work properly.
- 6. Check "TRIM TAB" control position.
- 7. Check altitude control. Place on "RICH" position.
- 8. Check carburetor heater control. Place on "COLD"

The pilot should then take a careful look around the cockpit to see if everything is in order.

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Form IA

The crew chief fills out this form and places it in the cockpit. On it he lists the amount of fuel and oil in the airplane, the total number of hours flown, and the hours flown that day. If there is any weakness in the airplane, he marks a red diagonal under Status Today. Under this circumstance the airplane cannot be flown unless the pilot signs the space marked Exceptional Release. When a major defect exists and the airplane cannot be flown, a red cross is marked in this space. If the pilot notices any weakness when he is flying, he makes a note of it under Remarks.



Other Forms

Form 60A. Technical Instruction Compliance Record, for the airplane.

Form 60B, Technical Instruction Compliance Record, for the engine.

These forms are used when some technical change is made in an airplane, or when an engine is overhauled.

Form 61. Propeller Historical Record. It shows when a propeller has been installed and when it is overhauled.

Form 41B. This gives all information about each airplane. Every inspection and when it was made, what has been done or not done, major overhauls, defects, and all other data are listed on this form. The engineering staff keeps it up day by day.



CRASH PROCEDURES AND FIRE FIGHTING

When an sirphere crashes at an sirfield, fire asset be controlled and injured airmen must be rescued with great speed. To do these things quickly, an airfield must have at least 1 crash truck parked near the hanger apron, ready for instant duty, and a welltrained crash crew.

A crash crew contains:

- 1. Crew Chief. He directs the crew or helps when quick action is necessary.
- Driver, He drives the truck and operates the firetighting pump.
- 3. Hand-linemen. They operate the hand lines, or

hoses, through which fire-entinguishing agents are aprayed. There are usually 2 hand-linemen to a crew.

 Rescuesses. They remove injured air crews from damaged aircraft. There are usually 2 rescuescen to a crew, but where it is impossible to have 2 men the crew chief serves as one of the rescuences.

The crash truck has:

- A Crask Kit. This includes equipment used to break into aircraft and in rescue work.
- 2. A First-Ald Kit.
- Fire-Fighting Equipment. This includes tasks of fire-fighting agents, which are explained under the heading Fire Fighting.

The critical period, particularly for endangered aircrews, is the first 60 seconds after a fire has broken out.

CRASH CREW, YOU SHOULD LEARN AS MUCH AS POSSIBLE ABOUT:

- 1. The airfield and surrounding countryside.
- 2. Approaching a crashed plane.
- 3. Location of airplane parts.
- 4. Getting into a crashed plane.
- 5. First Aid.
- 6. Fire fighting.

In proceeding to and from crashes, watch out for aircraft that may still be taxling, landing or taking off. One accident at a time is

bad enough.

The Airfield and Surrounding Countryside

Your crash crew should have a map of the airfield and the country surrounding it. This map should include roads, rivers, streams, hills and mountains, information as to type of country (such as wooded or brushy), and landmarks, both large and small.

If you are a member of that crew, you should make frequent trips into the country surrounding the airfield so that you will know it thoroughly. During these trips, mark on the map all possible ways of reaching any particular point. Your crew should have practice runs to predetermined locations.

Approaching the Crash

When you arrive at the scene of a crash, you must:

1. Remove all members of the air crew. If the crushed plane is afire, do this as quickly as possible. If there is no danger of fire, use great care and take all the time necessary to avoid aggravating the injuries of those hurt.

- Look for injured members of the crew who have jumped or parachuted.
- 3. Remove all nearby vehicles and aircraft.
- 4. Open Crash Kit and place in a spot easy to reach.

WHAT PLANES ARE THESE?





Chark your sorows on page 2-30

Location of Airplane Parts

A member of a crash crew must know how to get into a damaged airplane, what parts of the airplane are most dangerous, and where fuel lines are so that he can cut them off quickly.

To know these things, he must be familiar with parts of aircraft, in particular:

- 1. Materials used in aircraft.
- 2. Position of gasoline and oil tanks.
- 3. Fuel valves. Fuel line selector valves.
- 4. Electrical systems.
- 5. Openings.
- 6. Controls.
- 7. Special fasteners.
- 8. Landing gear.
- 9. Batteries.
- 10. Engines.
- 11. Crew positions in larger aircraft.

The only way to learn about aircraft is to get in them and study their parts, read about them, and watch while they are being dismantled.

Getting Into a Crashed Airplane (Not Afire)

One of the rescuemen enters the airplane. The other helps him from the outside. He gets in by:

- 1. Doors or escape hatches or, if that is impossible, by
- Breaking plexiglas or safety glass. As a last resort, he
- 3. Cuts a hole in the fuselage.

He must be careful not to cut through cables or connections that will increase the fire hazard. He makes a cut along 3 sides of a rectangle and opens the rectangle like a hinged door.

Inside the Airplane

Once inside the airplane the rescueman:

- 1. Determines condition of crew.
- Cuts off fuel selector switches, booster and transfer pumps.
- Removes hazardous materials such as flares or light pistols.
- Releases air crew from safety belts. He does not cut away safety belts unless absolutely necessary. Unsnapping them is easier and causes less damage.
- Removes crew from airplane carefully, especially if they are badly injured. Once out of the airplane, he moves injured members of the crew a safe distance from the wreckage and gives prompt medical attention.

Other Fectors in Crashes

- Ground (electrically) aircraft as soon as possible.
- Plug broken gas tanks with a soft wooden plug, putty or adhesive tape.
- Watch out for sparks. Do not wear nailed shoes as they will give off sparks when they come in contact with metal. Rubber shoes are preferable.





Fire Fighting

Fire-fighting equipment includes tanks of:

- Foam. A mixture of a powder and water that produces a frothy mass of bubbles. When this mass is played on a fire, it forms a blanket that excludes oxygen and chokes out the flames.
- Carbon diexide (CO_i). This is discharged as a heavy gas that smothers the flames. Like foam, it cuts off the fire's oxygen supply.
- Carbon tetrachloride. A heavy liquid that quickly forms a spray. It is used like carbon dioxide. Carbon tetrachloride is effective in temperatures below freezing.
- 4. Water. This is directed at flames through high-pressure, gun-type nozzles, or applied as fog-like spray. A straight blast of water extinguishes the fire and at the same time sweeps away gasoline vapors. A wide fog stream cools the air around a burning airplane and the surface of the airplane. It is excellent for covering rescue men who are attempting to get inside burning wreckage.

Here are some important points about fire fighting:

- 1. Attack with the wind.
- 2. Don't drive fire back into the cocknit.
- Direct form along edges of burning liquid and allow it to work back until the liquid is covered.

AIM AT BASE OF FIRE

- Direct carbon dioxide and carbon tetrachloride at the base of the flame. Use large amounts in mass attack.
- Sweep flames from side to side with high-pressure water and slowly drive back.
- Don't mix water and foom, for the foam will dissipate and be useless.
- 7. Cool gas tanks with a spray of water. Heat will expand and burst them if they are full.
- Do not direct high-pressure water streams at fuel burning in tanks, for they will spread the burning fuel.
- Watch out for flash-backs. Sometimes when a fire is out, a spark or heat combustion will re-ignite pools of fuel.

Removing Damaged Aircraft

Do not move a crashed airplane until you put out all fires and remove fuel. Moving might cause a shortcircuit in a broken wire and start a fire or cause an explosion. The only time an airplane should be moved during rescue work is in an emergency, when it is necessary to extract a member of the crew.

Before you remove a damaged airplane, be sure to:

- See that removal is coordinated with an Air Force representative if the airplane is Army property.
- 2. Turn all switches to the "OFF" position.
- 3. Disconnect batteries.
- Remove fuel. You can pump it from airplane tanks directly into a fuel truck.
- 5. Blanket completely with foam any fuel on the ground.
- 6. Remove all flares and signals.

If you cannot remove the airplane from the scene of the accident at once:

- 1. Anchor it securely.
- Place a guard over it to protect onlookers from fires that might start up again and to stop any tampering.

After an airplane is removed:

- I. Look over the entire area of the crash for fuel and oil that might have seeped into low areas.
- 2. Carefully burn all fuel on the ground.



HOW TO FIND YOUR WAY IN THE SKY

The culmination of everything you can learn about aviation comes when you climb into an airplane and start to fly if to a definite destination. But your knowledge of flying will be mouningless unless you know how to find your way over the face of the earth. The science of finding your way from one place on the earth to another by a desired route is called navigation. *This section of your manual explains the fundamentals of aerial navigation and discusses certain aids which, when used correctly, help you navigate an airplane. Among these aids, the aeronautical chart is most important. It is also assential that you know how to express time accurately, and know the relationship between time and distance. *In order to be able to fly the shortest distance between two points on the earth's surface through a constantly shifting mass of air, you must master the use of your navigation aids. Remember above all also to use them carefully and accurately.



IN THIS SECTION ...

Introduction to Navigation

Novigation as You Already Know It...Navigating at Sea...Navigating in the Air...Questions to Ask Yourself Before Beginning a Trip by Air...Selecting the Shortest, Quickest, Safest Route

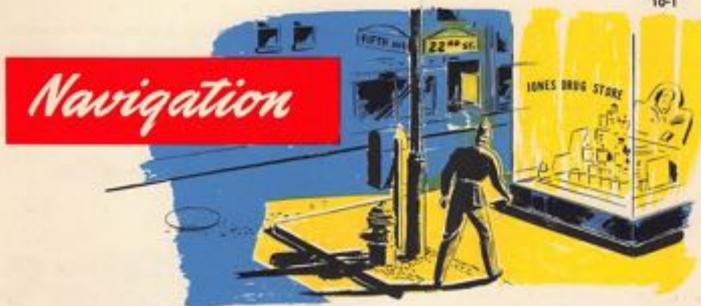
Maps and Charts

What a Map Is.—How Map Mickers Put Curved Surfaces on Flat Paper.—The Lambert Conformal
Sectional Chart That Aviators Use.—Best Features of it.—Scale of a Lambert Conformal.—How
This Chart Helps in Aerial Navigation.—Finding Your Position in Terms of Intersecting Streets.—How
Meridians and Parallels of Latitude Resemble Them.—How Meridians Are Numbered.—How
Farallels of Latitude Are Numbered.—Expressing a Position by Latitude and Longitude.—Divisions
of a Degree.—Locating Your Exact Position on an Aeronautical Chart.—How to Find Places on the
Ground When You've Located Them on a Chart.—Chart Symbols for Terrain Features.—Contour Lines.—
Chart Symbols for Water Features; Cultural Features; Airfields; Lights and Beacons; Radio Stations,
Obstructions—Importance of Having on Up-to-Date Chart

Direction, Distance and Time

Elementary Navigation

How Air Currents Affect on Airplane's Course—How and Why to Draw a Wind Triangle—How to Determine Your Compass Heading, True Heading, and Magnetic Heading—A Practical Problem in Aerial Navigation.



How do you navigate? How do you find your way. from one place on the earth to another? Answer the question yourself. When you go from home to school you follow the same street you have followed ever since you started going to school. That street helps you find your way. The street signs on every corner tell you that you are on the right street. You recognize familiar paths across vacant lots. You are navigating every day, and these familiar landmarks help you find your way.

When the captain of a boat starts out across the ocean for Europe or China or wherever he may be bound, he has to navigate to get where he wants to go. There are no street signs in the middle of the ocean to help him. There are no paths across vacant lots. And there are currents in the ocean that cause his boat to drift.

But bouts cross oceans every day. They don't get lost because the captain and his crew have ways of navigating. They use the stars and the sun and they know how the ocean currents are affecting their boat. They have certain aids that they use to replace the street signs. They know where they are going as they cross the ocean just as you do when you go to school each day, because they are just as familiar with their aids as you are with yours.

In the air you have a different problem. You are still trying to get from one place to another and you have to use aids to do it. The difference lies in the type of aids you use. The airman (anyone who flies



is called an airman) uses some of the aids you use in traveling around on the ground, and he uses some of the aids the ship captain uses in traveling over the ocean. But he also has some additional ones.

The airman uses a combination of aids. Before you can do this you must know the best way of using these aids. There are three things you must think about before starting on any air trip. They are:—

- 1. What is the shortest way to get to your destination?
- 2. What is the quickest way to get to your destination?
- Above all, what is the safest way to get to your destination?

It takes some thinking to figure out the shortest, quickest, and safest way to go to a particular place, but you must do it! Don't start until you have thought it over carefully.

Here is something to remember. Distance isn't always measured in miles. In the air, distance is measured in terms of time-hours and minutes. The quickest way to get to a destination is the shortest.

Be sure to choose the safest way to your destination. If you select a dangerous route you may never





get there. Pick the safest way you know. If there is a railroad tunnel through a mountain between you and school, you might save time by going to and from school through the tunnel. But the trains don't always run on time, and if you start through the tunnel you might get caught in the middle. It is safer to go around the hill. Therefore, you do so. It takes a little more time and it is a greater distance, but you know it is a safer way to get there.

When you are in the air you don't have to worry about tunnels, but you do have to worry about other obstacles. When you plan a flight you must avoid mountains and go around bad weather. It may take you longer to get to your destination, but you will be more sure of getting there.

You plan your flight with the aids you have. After you have done this intelligently, you start using those aids. But before you can use any aid you must know what it is and how it can serve you best. Let's discuss these aids one at a time. First, you must know what a chart is and how to use it.



A map is a representation of a portion of the earth's surface on a sheet of paper. The earth's surface is curved. The paper is flat. It is difficult to take a portion of a globe and flatten it and still keep things in their right relation to each other.

You can appreciate this better if you recall what happens when you take half an orange peel and press it flat. It splits at the edges and creases in the center.

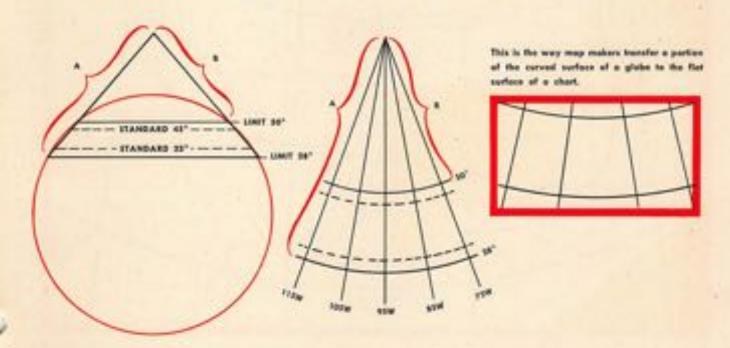
But the map makers have figured out ways of flattening a globe without greatly distorting the outlines of the continents or coast lines. Since this isn't a course in mathematics you don't have to learn how to build these maps. You only have to learn how to use them.

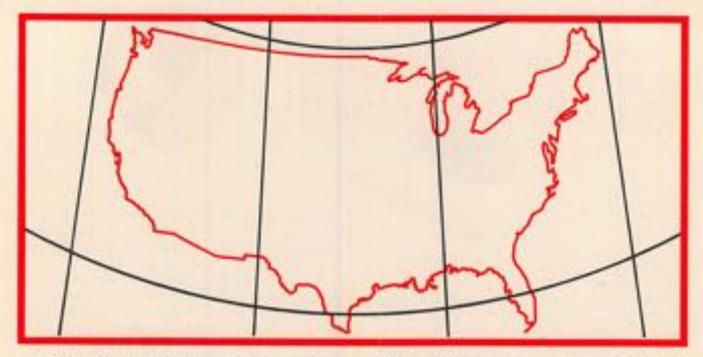
A map which is prepared for navigation is called a chart. A chart that is prepared for aerial navigation is called an aeronautical chart. Since you are studying aerial navigation you will use aeronautical charts only. The most common one is the Lambert Conformal sectional chart.

The Lambert Conformal chart shows the surface of the earth as if it were the surface of a cone. That is the way its makers construct this type of chart. The cone intersects the globe along two lines, called the standard parallels. The standard parallels are 33 degrees and 45 degrees north latitude, and a statement of that fact is printed in the upper right-hand corner of the chart. The area between these parallels is represented with a minimum of distortion on the Lambert Conformal—that's the important value of this chart.

Lambert Conformal Chart

Why do most airmen use the Lambert Conformal Chart? They have many reasons. Here are a few:

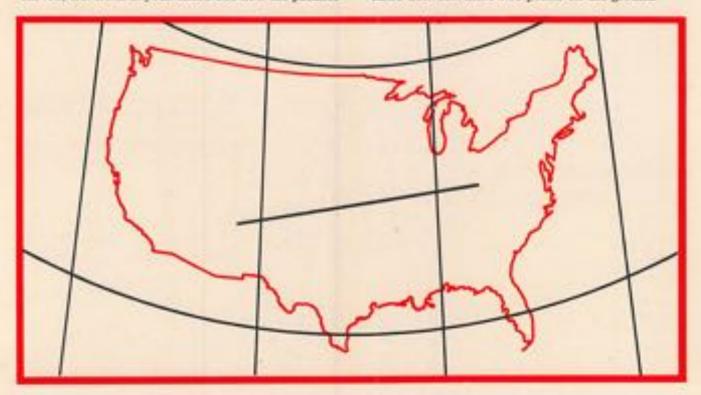




 It closely resembles the earth as you see it on a globe. The meridians point toward the pole on this chart just as they do on the globe. Look at your chart. Compare the meridians on the right side of the chart with the edge of it. They are not parallel.

The parallels of latitude are spaced equally on this chart, just as they are on the globe, and slightly curved, too. Look at your chart. See how the parallel at the top of it curves in comparison with the straight border.

- You can use the scale at the bottom of the chart to measure distances anywhere on it, because it is a constant scale.
- If you draw a straight line between two points on this chart, that line represents the shortest distance between those two points on the ground.



 This chart has little distortion. The land areas and water areas all appear on it in correct proportion.

Because the chart approximates the correct proportion and location of features on the earth, you can recognize landmarks from the air. This makes it ideal for the type of work the airman has to do.

The particular type of Lambert Conformal which you will use in this course is a sectional chart. This chart is so constructed that 1 inch on it is equal to approximately 8 miles on the surface of the earth. Actually, the scale is 1 inch on the chart to 500,000 inches on the earth's surface. That's nearly 8 miles. The scale of a chart is always printed in the upper right-hand corner. Always check the scale you are using.

Why should you always use the Lambert Conformal constructed to this scale? Because the scale is large enough to make the landmarks show up plainly, yet small enough so that it covers a large area of the earth.

In your CAPC course this is the only chart you will use, so always check the scale at the upper right-hand corner to make sure you have the proper one.

The chart is an aid to serial navigation because:

- 1. It helps you find your position.
- It helps you find the distance between any two points.
- 3. It helps you find direction.

Each of these advantages is important all by itself so they are discussed separately.





Location

When you are trying to locate a friend in a strange town you usually go into a drug store and reach him by telephone. You try to explain where you are so he can tell you how to get to his home. You tell him, for instance, that you are in Jones' drug store. If he doesn't know where Jones' drug store is, you have to give him better directions. What do you do? You go out to the corner and look at the street sign. The sign tells you that you are on the corner of 22nd Street and 5th Avenue. When you give your friend this information he knows exactly where you are and tells you in detail how to get from there to his home.

Why does he know where the corner of 22nd Street and 5th Avenue is when he doesn't know where Jones' drug store is? Because there is only one corner in the whole city where 5th Avenue crosses 22nd Street. In most towns the streets run north and

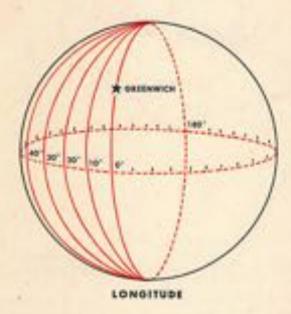


south, east and west. If they are parallel to a river or some prominent landmark and are numbered from that point, it is easy to tell where 22nd Street is. It is 22 blocks from the river. Streets running at right angles to one another actually form a system of coordinates. By naming two streets that intersect, you name a definite corner.

The captain of the boat wants to know where he is all the time, just as you want to know where you are all the time. He can't look up at a street sign. It isn't sufficient for him to know that he is in the Atlantic Ocean between the United States and Europe. He has to know his exact location in the ocean. By using the available aids he finds the geographical position of his boat and expresses that position by coordinates. These coordinates are different from the ones represented by intersecting streets but, like them, they are found by the intersection of two lines running at right angles.

When you go into the air you have the same problem as the captain of the boat. It isn't sufficient for you to know that you are somewhere between the Mississippi River and the Allegheny Mountains. You want to know exactly where you are. You can find your position over a definite landmark by referring to your chart. Express this position by using the latitude and longitude system of coordinates.

This isn't hard to do. Just as a river may be the starting point for numbering the streets in a town, there is a starting point for numbering the meridians and another for numbering the parallels of latitude.

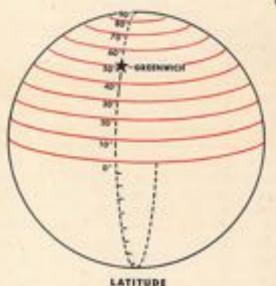


Greenwich, England is the spot where the numbering of meridians begins.

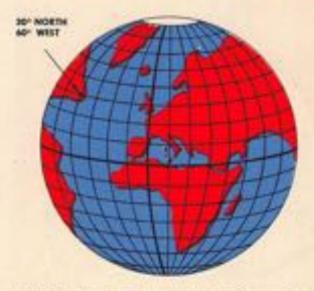
Starting with the meridian which passes through this point, we measure longitude. For this purpose, each half of the earth is divided into 180 parts. Each part is called a degree and is designated by the sign ". From the Greenwich meridian westward to the meridian exactly opposite it on the other side of the earth there are 180 degrees and from the Greenwich meridian eastward to that same point there are 180 degrees. Meridians are drawn through each of these degrees, and they are called degrees of longitude.

There are 180 degrees of west longitude and 180 degrees of east longitude. Since Greenwich is the starting point for numbering these meridians, you express your position by saying, for instance, that you are 45 degrees west of Greenwich, or you are at 45 degrees west longitude.

Now let's consider the other coordinate, latitude.



The distance along any meridian between either pole and the equator is divided into 90 parts. These parts are also called degrees. On a globe or chart they are indicated by lines parallel to the equator. Since the equator is their starting point, they are numbered from there to the pole. No matter where you are on the earth you are on a parallel of latitude, which is what this coordinate is called. You can tell the



parallel you are on by counting the number of degrees it is north or south of the equator. If you are north of the equator, you describe the point as being so many degrees north. If you are south of the equator, you describe it as being so many degrees south.

The entire earth is thus divided into a system of coordinates just like a well-planned town. The meridians run north and south and the parallels of latitude run east and west. Find which meridian you are on, then find which parallel of latitude crosses that meridian at your position. Any place you may be has a meridian and a parallel of latitude running through it. Therefore, you can always express your position in degrees of latitude and longitude.

A degree is further divided into 60 parts. Each part is called a minute. There are 60 minutes in 1 degree. The degrees are broken down this far so you can express your position more accurately. By expressing your position in degrees and minutes of latitude and longitude you can come within 1 mile of being exactly accurate. If you measure these coordinates carefully you may express your position even more exactly—within a half mile or even a quarter of a mile.

Measure latitude and longitude carefully, To read your longitude, lay a ruler or some straightedged instrument north and south over your position on the chart. Be sure the ruler is exactly north and south, parallel to the meridians. Now, read your longitude where the ruler crosses 2 parallels of lati-





tude. To find your latitude, use a pair of dividers to measure along the ruler. Measure up to your position from the parallel below it. Then, measure off that distance along the nearest meridian and read your latitude. What you've done is to find which meridian and which parallel of latitude intersect at your position.

Remember, an expression of your position by coordinates doesn't mean a thing unless it is exact. In fact, carelessness is misleading and dangerous,

Now that you know how to express your position by latitude and longitude, how do you find your position from the air so you can use this knowledge? Your chart describes landmarks such as mountains, rivers, towns and roads. Recognize a landmark directly beneath you. Find this landmark on your chart. Then, describe its position in latitude and longitude. The coordinates of your position are the same as those of the landmark because you are directly over it.

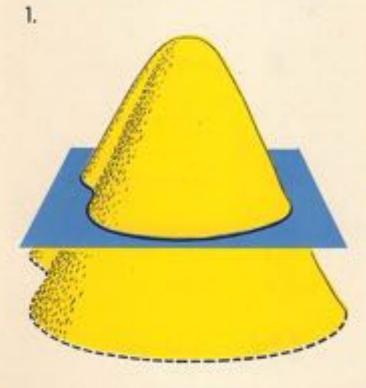
Your chart doesn't have a picture of a town, a realroad, a mountain, or a water tower, however. There are symbols on your chart that resemble but do not picture the landmarks represented. They are exaggerated in size so you can easily find them on your chart. You must learn what each symbol represents. Once you have learned these symbols you will recognize the symbol for a town of a certain size, for instance, and identify the town from the air. You will recognize the symbol for an airfield and then identify the airfield from the air. There are many landmarks which you will see from the air that are not shown on your chart. If every landmark were indicated on it, the chart would be all cluttered up. It contains only the information that is most useful to you.

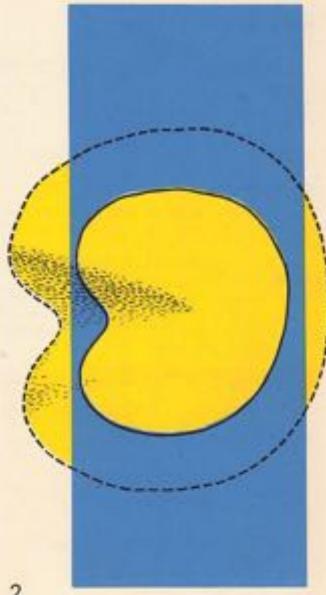
Look at your chart.

Terrain and Water Features

The first thing you notice is the colors. The colors are various shades of green and brown. These colors tell you how high the terrain is above sea level. Remember each color represents an altitude range of 1000 feet. For instance, the darker shade of green represents altitudes from sea level through 999 feet. A location shown in this shade may be any height from 1 to 1000 feet.

The next most prominent feature of the chart is its contour lines. A contour represents an imaginary line on the ground drawn through every point which





is the same height above sea level. The varied curves of the contour line reveal the shapes of ridges, valleys, canyons, bluffs, and other details.

Any contour is the intersection of an imaginary horizontal plane with the surface of the terrain. Figures 1 and 2 illustrate this. A sandpile 5 feet high stands on a pavement. An imaginary plane passes through the sandpile at a height of 2 feet. You are seeing it from the side and from above. As you look down on the sandpile, you can readily see how contour lines are formed.

Bodies of water are easy to see from the air. They are accurately represented on your chart as to shape and size.



Cultural Features

Many man-made features can be seen and recognized from the air. These features are called cultural features.

Towns and cities are the most prominent cultural features.

Only the more prominent paved roads are shown on your chart. When you see an unpaved road from the air it does not seem to have the same clean, gray appearance of a paved road.

Railroads are more difficult to see from the air than roads. They usually look like dark ribbons, and the rails themselves are seldom visible.

Miscellaneous cultural features are always shown in black.

Features which present a menace to air travel are always shown in red.

Prominent transmission lines may represent a hazard to air traffic; therefore, they are shown in red.

Pipelines are important because you can see from the air the right-of-way scars made for them.

Derricks and oil storage tanks are represented by symbols placed approximately over the area covered by the derricks or tanks. The symbol does not tell you how many there are, however.





Airfields

Airfields are shown in red because they are of prime importance to the airman. Their altitude above sea level is printed in slanting red figures.

The letters LF near an airfield mean that it has lighting facilities and it is safe to land there at night.



Lights and Beatens

Lights and beacons are shown in red on your chart because they are important aids to navigation. There are several types of beacons:

- Rotating beacons are spaced about 10 or 15 miles apart and form a light line that connects principal cities and towns. They sweep a beam of light in a circle 6 times every minute.
- The stationary beacon flashes in one position only.
- Some beacons have red code lights that flash.times per minute. The code is marked on your chart under the beacon symbol. You can see the code when you cross the light line or fly parallel to it.

When the flashing code light is green it means there is an airfield there with night landing facilities.

There are several combinations of lights and beacons.



Radio Stations

There are various types of radio stations and you can use them all to help you find your position. Most airplanes have equipment that will help you do this. On your chart the symbols for radio stations are also in red because of their importance.



Redio Marker Beacon (with traquency and identification signal)





Obstructions

An obstruction likely to be dangerous to air traffic is marked on the chart by a red inverted V and a numeral representing the height of the obstruction. Remember, this numeral tells you how high the obstruction is above the elevation of the ground. If the ground elevation is 4,000 ft, and the obstruction is marked 1,000 ft., that means it is 5,000 ft, above sea level.

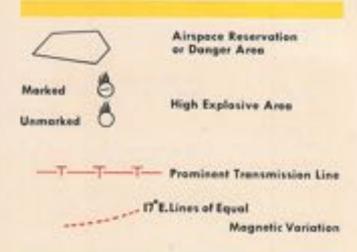
A restricted area is an area over which you must maintain a certain minimum altitude. The figure shown on the chart tells you the minimum altitude to maintain.

An airspace reservation is an area over which flight is forbidden.

You must learn what all these symbols represent and then be able to recognize the landmarks and navigation aids from the air.

Some prominent landmarks change from time to time. Lakes are formed by newly built dams. New roads are built. Towns change in size. The chart makers have to keep your chart up-to-date, and they do their best. But they can't publish a new chart as often as landmarks change because it is too expensive. They do tell you when your chart was published, however. The date of publication is printed in red in the lower left-hand corner. Always use the most recent chart available.

You now know how to express any position by latitude and longitude, and you know what the chart symbols represent. It is important that you know this. But when you leave your departure point you must also know how far your destination is. Your chart helps you determine distance.





You measure distances in miles on your chart, and the mile you use has 5,280 ft. in it. This is a statute mile. There is a scale on the bottom of your chart that helps you measure distances. Use this scale anywhere on the chart, but be sure to measure distances accurately.

A big advantage to you in measuring distances on an aeronautical chart is the fact that you fly from one place straight to another. You don't follow the twists and turns of a highway. Just measure the straight line between departure and destination.

Now that you know how to use your chart, you have mastered the use of one of the aids to air navigation. This is the single most important aid you have and you must use it accurately.

Direction

To get to your destination you must also know which direction to take.



You don't worry about the direction you are traveling when you travel on the ground, because you only have to follow a street or a road, read the signs and follow the arrows. Direction is taken care of for you. The roads lead to where you want to go, so you fellow them.

The captain and crew of the boat don't have any roads to follow across the oceans, so they must use some other means of taking the right direction. They use a compass, which is a direction-finding instrument.

The airman has a problem similar to that of the captain of the boat. He can't fly down a highway, reading arrows and signs. So the airman uses a com-

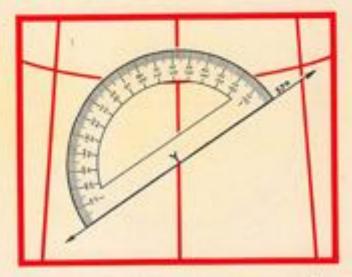
Compass

pass also. He calls the direction between his departure and destination his course.

How do you measure your course? The airman expresses direction in degrees measured clockwise from true north. True north is the direction from any point to the geographic North Pole.

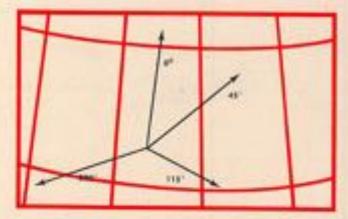
You remember that every circle has 200 degrees. A circle indicating all directions is called a compass rose. There are compass roses on the chart you are using.

When planning your flight you first draw a line between the points of departure and destination. This line is called your true course. To measure the direction of this course you use a protractor, which is half a compass rose.

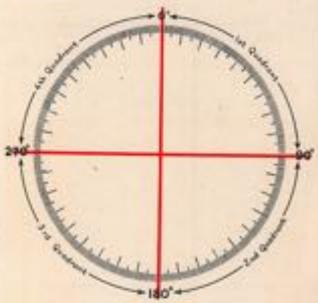


Place the index of the protractor over a meridian and along a line you want to measure. Read the direction of the line where the meridian cuts the protractor. If your course is easterly, read the figure on the protractor as it is. If your course is westerly, add 180 degrees to the reading you get on your protractor. Always use the meridian half way between your departure and destination points on which to measure the course between those places.

Remember: Always add 180 degrees to the reading of your protractor when you have a westerly course.



Pick out any position on your chart and express that position by latitude and longitude. From that position draw lines in several directions. Starting at North, which is 0°, measure the direction these lines are pointing from your position. Express these directions or courses in degrees from 0° to 360°, clockwise from North.



Whenever you measure a course, remember this simple diagram:

The first quarter (or quadrant) is the 0°-90° quadrant; the second, the 90°-180° quadrant; the third, the 180°-270° quadrant; the fourth, the

270°-360° quadrant. If your course line is in the first quadrant the course angle cannot exceed 90°. If it is in the second quadrant the angle must be between 90° and 180°. If the course line is in the third quadrant the angle must be between 180° and 270°. If the course line is in the fourth quadrant, the course angle must be between 270° and 360°.

Keep this diagram in mind. You can glance at a course line, determine which quadrant it is in, and estimate the approximate course angle. This will help you eliminate large mistakes in measuring course.

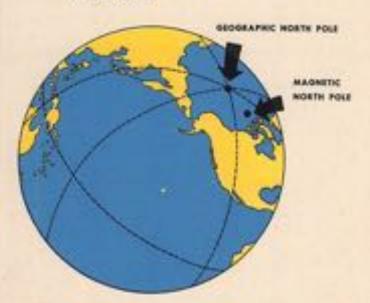
The compass that airmen use is a magnetic compass. Its principle and purpose are described in Section 6, "What Makes an Airplane Fly." It is an accurate and dependable instrument in the hands of the pilot or navigator who knows how to use it. But it is subject to two types of errors:

- 1. Flight errors.
- 2. Inherent errors.

Flight errors are not discussed in this section, but are described in Section 6.

Inherent errors must always be considered. They are:

- 1. Variation.
- 2. Deviation.



Variation is caused by the fact that the needle of the magnetic compass points to the earth's magnetic pole. Unfortunately the magnetic north pole of the earth is not in the same place as the geographic North Pole.

You have just learned to measure your course from true north. Your compass, however, gives direc-



tion from magnetic north. The angle or difference between these two directions from your position is called variation. Because of the way the earth is made, this variation is different at different places on the earth.

Find the amount of variation of your flight area on your chart. This is shown by heavy dashed lines, called isogenic lines, which connect points of equal variation. If you cross several such lines in one flight, figure the average amount of variation and use that figure.

Variation is either easterly or westerly. Apply variation to your true course. Add westerly variation; subtract easterly variation. True course corrected for variation is called magnetic course.

Deviation is the compass error caused by the nearby magnetic sources in the airplane, such as the proximity of iron parts and the electrical current in the radio or electrical system. You will find the amount of deviation of your compass on a card installed on the instrument panel. It is called a compass card.

Apply deviation, as it is indicated on the compass card, to your magnetic course. Magnetic course corrected for deviation is called compass course.

A compass course is the course which you must steer in order to compensate for the two inherent compass errors.

True course ± variation - magnetic course,

Magnetic course ± deviation — compass course. Here is an example:

Your true course is 275°, Variation of your flight area is 7°E. Your compass card indicates: For 270° steer 273°.

True Course	275"
Variation	-70
Magnetic course	.268*
Deviation	
Compass course	.271

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Time

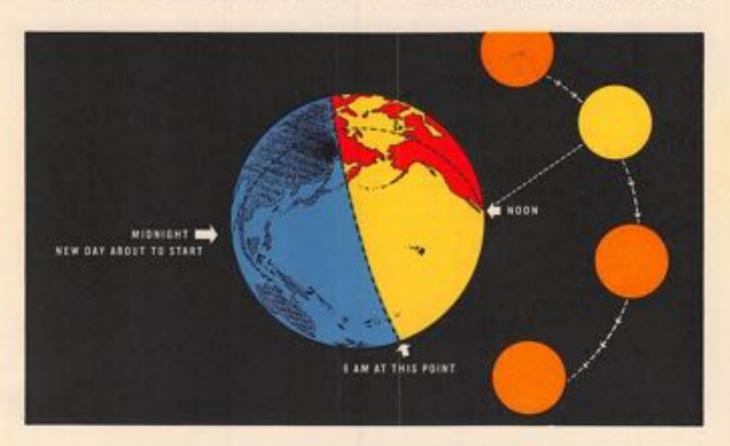


From early days man measured time by watching and noting the movement of the sun across the sky. He drove a stick into the ground and observed that its shadow moved as the sun crossed the heavens. We now know, of course, that the apparent movement of the sun is caused by the rotation of the earth around its axis. But since the sun seems to move around us, we shall pretend here that it is actually doing so.

The period of time it takes the earth to complete

one rotation is called a day. A day in this sense includes both the time of daylight and darkness. It is divided into 24 hours. Each hour is further divided into minutes and seconds.

At any place on the earth when the sun is highest on its daily trip across the sky it is noon or mid-day (12 o'clock). Twelve hours before, when the sun was exactly opposite, on the other side of the earth, the day started for this particular place. Twelve hours after mid-day, the sun, having completed a circle, is



again exactly opposite the spot of which we are speaking. It is now midnight there and a new day is about to begin.

All people on the same meridian, regardless of the latitude of their position, have the same time. They have noon and therefore every other hour of the day at the same time. But remember, this is true only of people on the same meridian.

For instance, when it is 12 o'clock in West Palm Beach, Fla., the clocks in Charleston, S. C., Erie, Pa., and in Parry Sound, Northern Ontario, also indicate 12 o'clock. That is because these places all are located along the meridian of 80° west longitude.

On the other hand, when it is noon for the people who live on the meridian of 80° west longitude, according to the position of the sun it is not yet noon

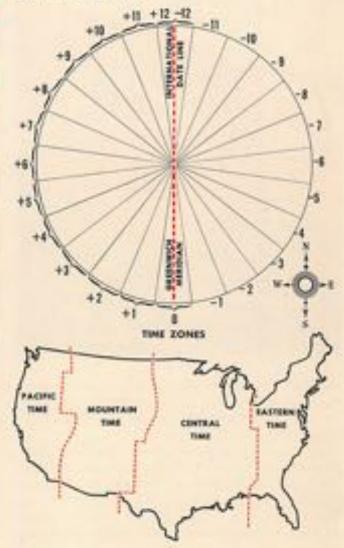
TI:52 AH WALLESTON, CONT.

for those who live at 82° west longitude. That's because it takes the sun a certain amount of time to travel the additional 2 degrees.

How long does it take the sun to travel this distance? It completes a circle in 24 hours. Every circle has 360 degrees. Therefore, the sun travels 15 degrees of longitude every hour and 1 degree every 4 minutes. Accordingly, it will take 8 minutes for the sun to cover the 2 degrees of distance between 80° and 82° west longitude. When it's noon at 80° west it is 8 minutes before noon at 82° west.

According to the movement of the sun, no two places east or west of each other have the same time. For practical reasons it was decided to establish time zones. These are large areas within which all people set their watches to the same time. They use the time of the meridian passing through the middle of their zone. This meridian is called the standard meridian of the respective time zone and the time that is used in the entire zone is called standard time. It is also known variously as zone time, mean time, and civil time.

Twenty-four time zones were established, each zone covering 15 degrees of longitude, except where local situations such as the position of state borders had to be considered.



These time zones are centered on 24 standard meridians beginning with the meridian passing through Greenwich, England. This is the zero meridian.

People on the ground travel at comparatively low speeds and only occasionally cross the borders of time zones. Whenever they cross the border of a time zone in an easterly direction they must set their watches I hour ahead. This is because the sun travels from east to west, while they are rooving in the opposite direction. When they cross the border of a time zone in a westerly direction they set their watches back I hour, for they are catching up with the sun.

Airmen, traveling at high speeds, frequently cross several time zones on a single trip. Therefore it is particularly important for them to understand and



he able to express time accurately. They always must be conscious of which time zone they are in. When they express their time they must not only give the hour but also the time zone.

To avoid misunderstanding and to simplify communications, airmen do not express time as a.m. and p.m. They use the 24-hour clock, On this clock the morning hours are numbered as usual but the hours from noon to midnight are numbered from 13 to 24. Moreover, the afternoon and evening hours



are spoken of as thirteen hundred, fourteen hundred, and so forth.

Never attempt to solve a time problem in your head. Always do it on paper,

Here is the way to do it:

What is 12:42 Eastern Standard Time in Pacific Standard Time? EST is based on 75° west longitude, the standard meridian of the eastern time zone. PST is based on 120° west longitude. The difference in longitude between them is 45 degrees. Therefore, the difference between Eastern Standard Time and

Pacific Standard Time is $\frac{45^{\circ}}{15^{\circ}}$ or 3 hours. Since you are expressing the time of an eastern time zone in terms of a time zone further west you must set your watch back 3 hours.

12:42 EST minus 3 hours equals 09:42 PST.

Here is another example:

What is 15:10 Central Standard Time in Greenwich Standard Time?

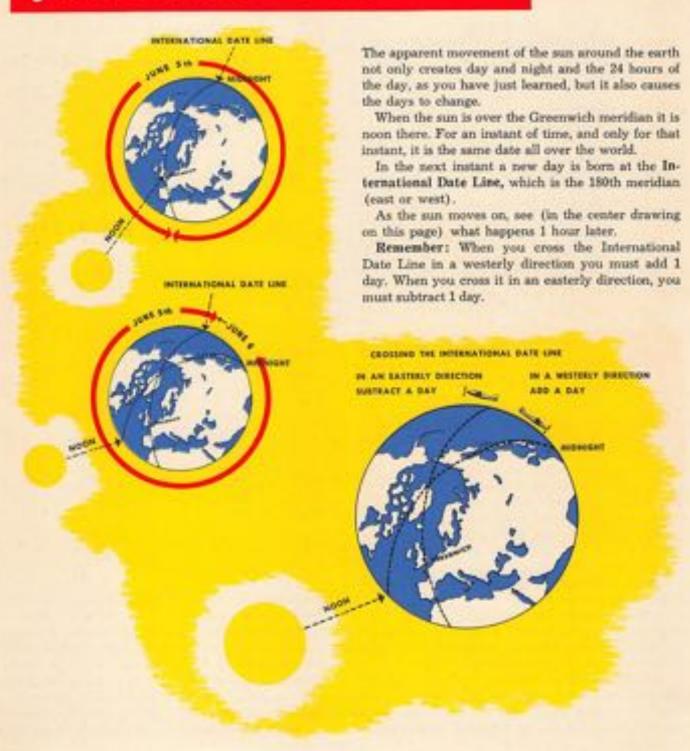
CST is based on 90° west longitude. Greenwich Standard Time is based on 0°. The difference in longitude between these standard meridians is 90°

degrees. The difference in time is $\frac{90^{\circ}}{15^{\circ}}$ or 6 hours.

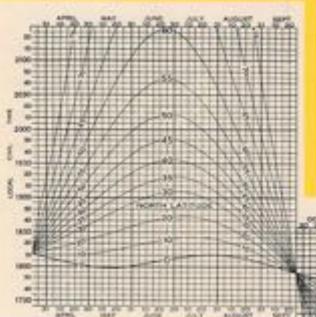
15:10 CST plus 6 hours equals 21:10 GST. Remember, in this case you must set your watch ahead. You are figuring time in a time zone east of yours.

Clocks have been set ahead 1 hour in many time zones because of the war. This was done to increase the amount of daylight in a normal work day. It is called war time. It creates some complication in your time problems but not a serious one. To change war time to standard time, subtract 1 hour.

International Date Line



SUNSET TABLES



east of the standard meridian in this time sone.

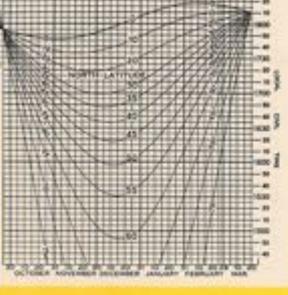
For example: Find the sunset time for May 20 at 23°00' N latitude and 94°30' W longitude.

- Enter the top or bottom scale with the proper date, May 20.
- Move vertically down or up to the curve for your latitude, 33°80°. Since this exact latitude is not shown on the chart, you must estimate its approximate position between the 30° and 35° lines of latitude.
- Move horizontally to the right or left and read the local standard time on the vertical scales at the side—18:55.
 - 4 To find the correct zone or standard time

When you start on a trip in an airplane it is important for you to know when you will arrive at your destination. You will always try to get there before the sun goes down so you can land before it gets dark. There are tables prepared to help you find the time of sunset at your destination.

This is how you use them:

- Enter the top or bottom scale with the proper date.
- Move vertically down or up to the curve for your latitude.
- Move horizontally to the right or left and read the local standard time of sunset on the vertical scales at the side. The tables give you the time of sunset at any standard meridian.
- 4. To find the exact zone time of sunset for any location not on a standard meridian, add 4 minutes for each degree west of the standard meridian in this time zone and subtract 4 minutes for each degree



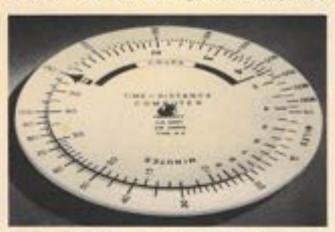
of sunset, add 4 minutes for each degree your destination is west of the standard meridian. Your longitude is 4°30' west of the standard 90th meridian (Central Standard Time). Therefore, 4½ × 4 (18 minutes) is added to 18:35 to get the time of sunset—19:13 Central Standard Time. If you have war time on your watch, when the sun sets at your destination the watch will read 20:13 CWT (Central War Time).

Always try to reach your destination before the

sun goes down, so you won't have to make a night landing.

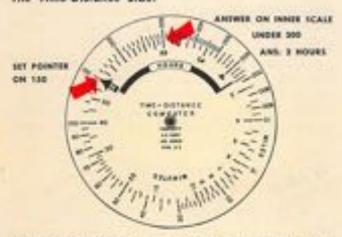
You have been given enough aids now to start some elementary navigation. You know how to find and measure location, direction and distance on your chart. You know what the symbols mean, and you understand time. Elementary navigation is a combination of these aids.

How to Use the Navigation Computer, TYPE D3



The D3 navigation computer is a simple, circular device which was constructed to help you solve timedistance problems and figure true airspeed from indicated airspeed. It has scales printed on both sides.

The Time-Distance Side:



On the time-distance side of your computer, the outer, stationary scale is marked in miles. The inner, movable scale is in minutes and hours. Also on the inner scale is a black arrow. This arrow is at the I hour mark.

If, for an easy example, the distance between your departure point and destination is 300 miles and your groundspeed is 150 miles per hour, it will take you 2 hours to get to your destination. You can figure

this in your head. But work it on the computer.

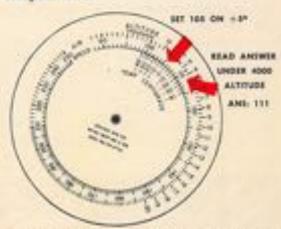
If you are going 150 miles per hour, set the 1 hour pointer (the black arrow) under 150 on the outer scale. Then look under 300 miles. Two hours on the inner scale is opposite 300 miles on the outer scale.

Always set the black hour pointer opposite your groundspeed and you can find how long it will take you to go any distance merely by looking at the minutes and hours scale under the number of miles.

If you have traveled a certain distance in a certain number of hours and minutes, set the time under the distance on your computer and look at the figure above the pointer. That is your groundspeed.

If, for instance, you have traveled 240 miles in an hour and a half, place I hour and 30 minutes under 240. Look at the figure above the pointer. Your groundspeed is 160 miles per hour.

The Airspeed Side:



The other side of your computer is constructed to figure true airspeed from indicated airspeed. The word true is significant.

As you know, every airplane has an airspeed indicator. It is described in detail in the section entitled What Makes on Airplane Fly. This instrument is accurate and reliable but its reading requires a correction for altitude and temperature. True airspeed is the actual speed at which you are traveling through the air. It is the indicated airspeed corrected for altitude and temperature.

The side of the D3 computer which was designed to help you determine this correction has an altitude scale along its outer edge and a temperature scale inside the altitude scale. On a smaller, revolving disk there is an airspeed scale in miles per hour, ranging from 88 to 250.

To change indicated airspeed to true airspeed, set the indicated airspeed to the temperature at flight level, and read true airspeed against your altitude on the outer scale.

For example:

How much is your true airspeed if your indicated airspeed is 105 miles per hour, the temperature at flight level is +5°, and your altitude is 4,000 feet?

Set 105 (on the inner, revolving scale) against +5° on the temperature scale. Then rend your true airspeed, 111 miles per hour, below the altitude figure, 4 (representing thousands of feet), on the outer scale.

Make up other problems to give yourself practice using the computer.

Remember: True airspeed is the actual speed at which you are traveling through the air.

Groundspeed is the actual speed at which you are traveling over the ground.

Elementary Navigation

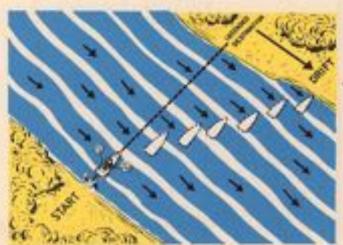
Time, speed, distance, and direction

When you are driving your car down a highway your direction is determined for you by the road, and your speedometer tells you how fast you are going. You merely follow the road. In the air you are in a shifting element. It is constantly moving and your airspeed indicator only tells you how fast you are moving through it—not how fast you are moving ever the ground.

Your problem is like that of crossing a river in a boat. The water in the river is moving downstream. The movement of the water is called a current. You want to go straight across the river. But if you point your boat directly at the opposite shore the current carries you downstream. There are two forces acting on the boat. The oars are pushing it forward and the current is carrying it sideways. In the air you are in a current all the time. If you leave your departure point with your airplane headed directly towards your destination, you will arrive there only if there is no wind. But there is always a wind. The air is never completely calm. So there will be two forces acting on your plane just as there were two forces acting on the boat.

With a boat in a stream, you find that you can go straight across if you head upstream at a certain angle. By selecting just the right angle you can compensate completely for the effect of the current, which is trying to push you downstream.

In planning a flight, your problem is similar. You must find out how much you have to head into the wind in order to counteract its effect. You do this with the help of a vector diagram, commonly called a wind triangle, A vector is a line representing both







direction and force.

By drawing this simple triangle you can figure out just how much you must head into the wind in order to travel over the ground in the direction you want to go.

Suppose you want to fly from Altus Airport, Okla., to Midway Field at Clinton, Okla., a distance of 62 miles. Your airplane, we'll say, cruises at an airspeed of 100 miles per hour.

First, draw a line on your aeronautical chart connecting the two points. This is your true course and you find, by measuring, that it is 22°. The variation in your flight area, as the chart indicates, is 11° E. Let's assume that the deviation given on your compass card is +4°. Therefore, your compass course is 15°. It is figured this way:

True course	
Magnetic course	
Compass course	150

These corrections have taken care of your compass errors, but if you were to hold a course at 15" you would get from Altus to Clinton only in a dead calm. This, as you know, is never possible. The air is always in motion.

By getting in touch with the Weather Station, you learn that there is a wind of 20 miles per hour from 325°. The purpose of the wind triangle is to find out how to correct your course to compensate for this wind. Since speed is always given in miles per hour, always draw a wind triangle on the basis of 1 hour, no matter how long or short the trip. Also, you must



select a practical scale to represent miles per hour on the diagram you are going to draw and use that scale throughout the problem.



On a piece of paper of suitable size to illustrate your problem, draw a vertical line representing North-South. (Figure 1.) Print an N at the top of it.

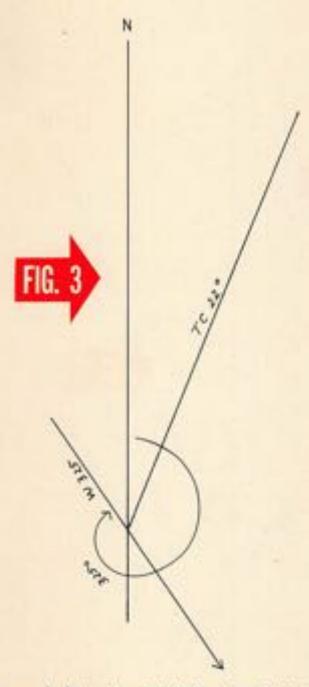
Along this line, select a point representing your place of departure. From this point, draw a line in the direction of 22°. This represents your true course . . . the line on your chart between points of depar-

WHAT PLANES ARE THESE?





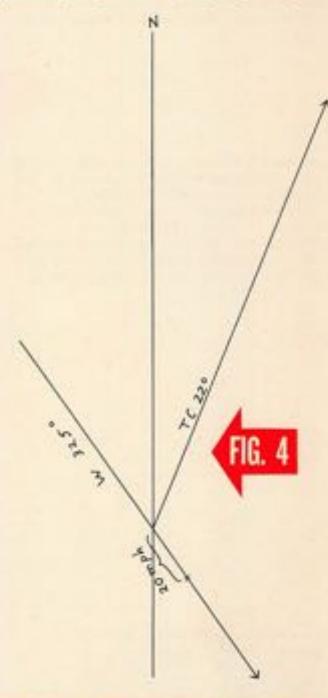
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ture and destination. Label the line: TC-22", (Figure 2.)

Now, through the same point, draw a line from 325°. This is your wind line. Label it W-325°. (Figure 3.)

Note that you have to draw the wind line through your starting point. This is important. To emphasize it, draw an arrowhead at the end of the line, to point out the direction into which the wind is blowing. Because the wind is moving in that direction, its force acts in that direction, too. Your wind line now shows only the direction of the wind. You must next indicate its velocity. Using the scale you have chosen, measure off 20 miles (velocity per hour) along the wind line, beginning at the point



representing your place of departure. Be sure to measure in the direction the wind is blowing.

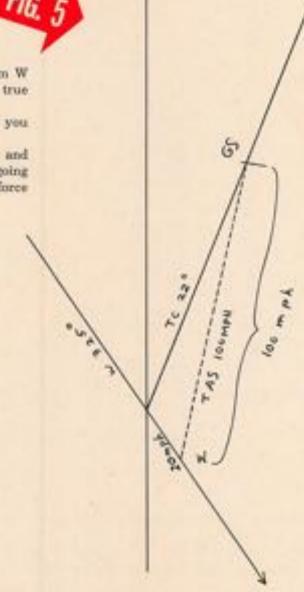
Having made a point on this line to represent 20 miles per hour, mark it W, for it is called the wind point. Your diagram now shows both the direction and velocity of the wind for a period of 1 hour. (Figure 4.)

Next, measure off 100 miles according to your scale. This is your true airspeed for 1 hour. From point W, find where this line intersects the line of your true course. When you have determined that

point, mark it GS and draw a dashed line from W to GS. (Figure 5.) This line represents your true airspeed. Therefore, label it TAS-100mph.

Your wind triangle is now complete, and you can read on it what you want to know:

The angle between your true airspeed line and your true course line is the amount you are going to have to correct your course to counteract the force

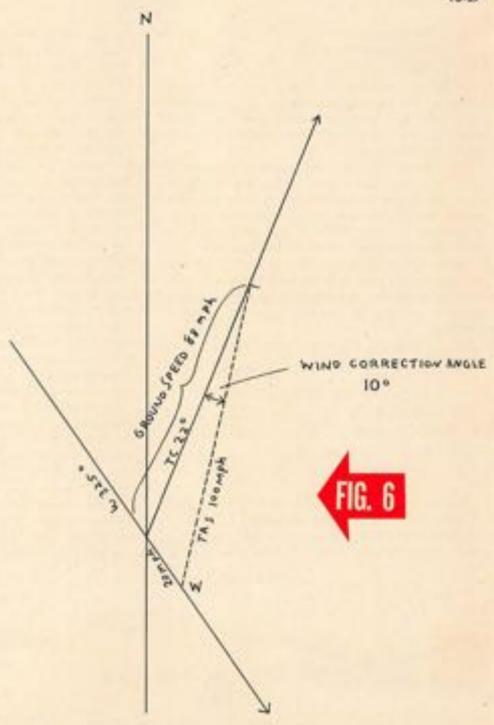


WHAT PLANES ARE THESE?





Check your es page 3-30



of the wind. Accordingly, it is called the wind correction angle. Measure it with your protractor and you will find it is 10°. (Figure 6.)

You previously found that your compass course is 15°. Your wind triangle shows you that the wind correction angle is 10°. Do you add or subtract this angle?

In relation to the direction of your course in this problem the wind blows from the left. In order to counteract its effect, you therefore must correct to the left, just as you must head a boat upstream to counteract the river current. Whenever you correct to the left, you must subtract your wind correction angle. Therefore:

Compass cou	me		15	i
Wind correcti				
Compass hear	ling	153		ï

As you see, compass heading is your true course corrected for variation, deviation, and wind. You have found that in order to make good the desired true course of 22° the magnetic compass of your plane will have to read 5°.

The result is the same no matter in what order you apply these corrections. So far, we have gone from true course to magnetic course, from magnetic course to compass course, and from compass course to compass heading. Often, it is more practical to make these corrections in the following order:

Apply the wind correction angle to your true course and get your true heading. Apply variation to the true heading to get magnetic heading. Correct magnetic heading for deviation and get compass heading.

In your problem, this would work out in the following manner:

True course	22
Wind correction angle	
True heading	12
Variation (E)	-11°
Magnetic heading	1
Deviation	+4"
Compass heading	. 5"

You see, the result is the same. Note that a course corrected for wind is called a heading.

Remember: When the wind is moving you to the right, always correct to the left. When the wind is moving you to the left, always correct to the right. Whenever you correct to the left, it is a minus correction. Whenever you correct to the right, it is a plus correction.

On the wind triangle which you drew, the distance from your starting point to the point GS represents your groundspeed. That, you remember, is your actual speed over the ground. Measure it at your scale and you find it is 88 miles per hour. This means that, because of the wind, though you are flying at a true airspeed of 100 miles per hour, you are traveling over the ground at a speed of only 88 miles per hour.

In a wind triangle, the groundspeed is always found along the true course line and the true heading is the direction of the true airspeed line.

Remember: In speaking of wind triangles a key word is true. When you draw one, always use true course and true sirspeed.

You previously measured on your chart the distance from Altus Airport to Midway Field and found it to be 62 miles. Your wind triangle shows you your groundspeed is 88 miles per hour. To find out how long your trip will take, consult your D3 computer.

Set the black pointer at your groundspeed, 88 miles per hour. Now read the number of minutes under the distance, 62 miles. You find it is about 42 minutes. Accordingly, if you take off from Altus Airport at 10:00 CWT, you can correctly estimate that you will arrive at Midway Field at 10:42 CWT.

If you know how to read your chart, if you understand time, if you can draw a wind triangle, and if you know how to operate your computer, you have learned elementary aerial navigation.



Other Aviation Books Worth Reading

COMPILED BY THE CIVIL ARRONAUTIES ADMINISTRATION

ASROSPHERS'S MODERN AIRCRAFT, Aurosphere, Inc., New York, 1943, \$7.50.

AREONAUTICAL OCCUPATIONS, Bur W. Layson, E. P. Durson and Co., New York, 1941, \$2.00.

A GUIDE TO AERONAUTICAL OCCUPATIONS. Busing School of Aeronoutics, Ocklond, Calif., 1740. He thoron.

AMERICANT IDENTIFICATION MANUAL. Shelley M. Erister, Amerika Callege, Ameriko, Tex., 1942. Price not stored.

AIRCRAFT SILHOUSTES, Air Youth Division, Notional Acronautic Association, Westington, D. C., 1943, 5.15 per chort.

ASE NAVIGATION, Herbert S. Zim. Hursport, Broce and Co., New York, 1943, \$3.00.

ASS NAVIGATION FOR SEDINHESS, Sout G. Lands. The Hormon W. Hantey Publishing Co., New York, 1943, 51.50.

A PSLOT'S MITEOROLOGY, Charles Graham Halpine, D. VanNostrond and Co., New York, 1941, \$7.50.

BEFORE YOU FLY, Pearle Thurber Robinson, Frederic A. Middleton, George M. Rowlins, Jr., and Joseph W. Phillips. Heavy Half and Co., New York, 1943, 52.75.

CIVIL ARE RECULATIONS, Fort 60. Civil Agreementics Bound, Washington, D.C., 1943. S.10. (Order from Superintendent of Documents, Garanteend Printing Office, Washington, D. C.)

ELEMENTARY SCHOOL SCIENCE FOR THE AIR AGE, Charles K. Arey, The Mocalillan Co., New York, 1943, 5.72.

ELEMENTS OF PRE-FLIGHT AERONAUTICS FOR HIGH SCHOOLS, The Mountless Co., New York, 1942. 5.95.

NUMAN GEOGRAPHY IN THE AIR AGE. George T. Revent. The Manuflux Co., New York, 1942. S.64.

OPERATION OF AIRCRAFT ENGINES, McGrow-Hill Book Co., New York, 1742, 2.70.

PHYSICAL SCHNES IN THE AIR AGE, J. G. Monzer, M. M. Prolin, and J. M. Lege. The Macadius Co., New York, 1942. 5.80.

PRINCIPLES OF AIR NAVIGATION. Best A. Shintib. AdGress-100 Book Co., New York, 1943. \$1.60.

PRINCIPLES OF PLIGHT, Bert A. Shields, McGrew-Hill Book Co., New York, 1943, \$1.86.

SCIENCE OF PRE-FLIGHT AIRONAUTICS FOR HIGH SCHOOLS. The Macmilles Co., Now York, 1742, \$1.32.

SOCIAL STUDIES FOR THE AIR AGE, Bull Burtlett, The Manuallian Co., New York, 1942, S.CO.

SUMMARY OF U. S. CIVIL AIR REQULATIONS, G. S. Brandon, Maryday Pight Co., Konson City, Ma., 1943. S.St.

TEACHERS' SOURCE MATERIAL ON AVIATION. Los Arquins County Schools, Son Angeles, Calif., 1940. Price not stored.

THE AIR WE LIVE IN. George T. Sensor and Subart Sasar. The Magnillan Co., New York, 1942. \$36.

THE AMPORT, Charles K. Arey. The Maunillan Co., New York, 1943. 5.36.

THE SET'S THE LIMIT. Charles Gilbert Half and Rodolph A. Markle. Flok and Wagnets Co., New York, 1943, \$2.00.

VISIBILITY UNLIMITED, Erect G. Vetter, William Morrow and Co., New York, 1942, \$3.50.

